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LAKE MICHIGAN WATER QUALITY REPORT
1984

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JAN 3 1986
UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

A COOPERATIVE MONITORING AND REPORTING EFFORT BETWEEN THE CITY OF CHICAGO AND THE STATE OF ILLINOIS

4th March 1837

Aug 26th 1818

LAKE MICHIGAN
WATER QUALITY REPORT
JANUARY THROUGH DECEMBER, 1984

by

THE CITY OF CHICAGO
DEPARTMENT OF WATER
BUREAU OF WATER OPERATIONS
DIVISION OF WATER PURIFICATION
WATER QUALITY SURVEILLANCE SECTION

and

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF WATER POLLUTION CONTROL
MONITORING UNIT

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WATER QUALITY SUMMARY, 1984

The data obtained from the 1984 Lake Michigan Survey Program, as presented in Table 1, is the basis of this water quality summary. The table lists the arithmetic and geometric means for various chemical and microbiological parameters in three groups: nearshore, less than three miles from shore; offshore, more than three miles from shore; and all station, combining nearshore and offshore points (Figure 1). The grouping of data in this manner provides a means for evaluating the effect of effluents, tributaries, and runoff into Lake Michigan. During the 1984 survey season there were 156 nearshore and 138 offshore observations, for an all station total of 294 observations for most chemical and microbiological parameters.

The chemical and microbiological data collected during 1984, when compared to previous years, indicates improvement in water quality for the extreme southwestern portion of Lake Michigan.

Only those parameters analyzed most often and those assigned a water quality standard as listed in 35 IL. Adm. Code 302 will be evaluated and discussed further in this summary. They are total coliform, fecal coliform, ammonia nitrogen, total phosphate, chloride and sulfate.

In 1984, the total coliform levels for the nearshore stations averaged 16/100 mL, up from 12/100 mL in 1983, but still below 1982 and 1981 levels of 29 and 68/100 mL, respectively. The offshore stations averaged one organism per 100 mL in 1984 as compared to zero organisms in 1983 and one organism per 100 mL in 1982. The all station annual mean for total coliform increased slightly to 9/100 mL in 1984 from the record low of 7/100 mL in 1983, still below the 1982 and 1981 annual means of 16 and 38/100 mL, respectively. The differences between 1983 and 1984 are not significant and are likely due to inherent variability.

Table 1.

SOUTHWESTERN LAKE MICHIGAN
WATER QUALITY EVALUATION
1984

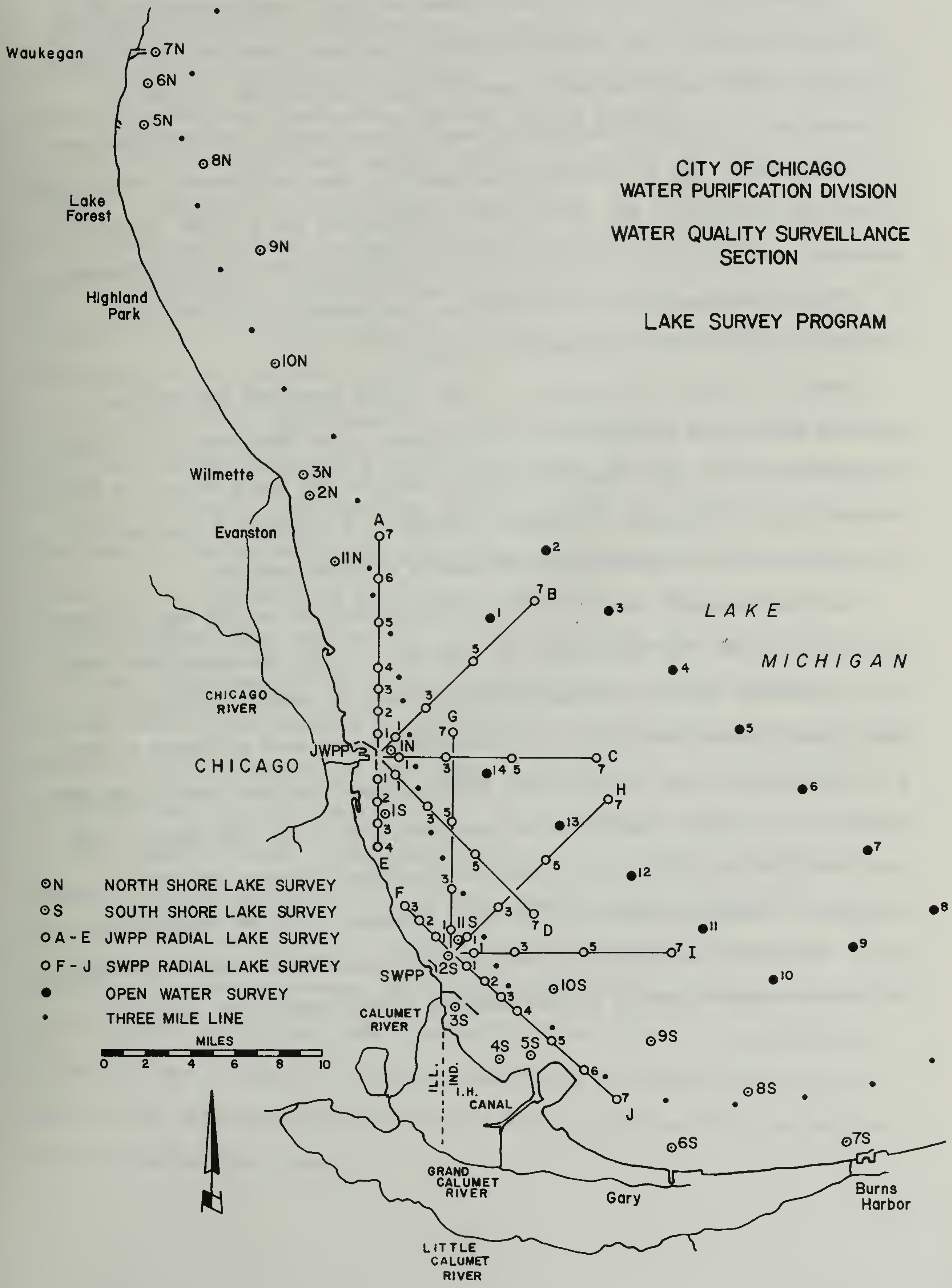
PARAMETER		STANDARD	NEARSHORE (1) less than 3 ml. from shore		OFFSHORE (2) more than 3 mi. from shore		ALL STATIONS	
			AVERAGE	NO.	AVERAGE	NO.	AVERAGE	N
TURBIDITY	N.T.U.		1.67	156	0.71	138	1.22	29
ODOR, THRESHOLD	T.O.N.		1	156	1	138	1	29
CONDUCTIVITY	μmhos		288	156	284	138	286	29
OXYGEN DEMAND, CHEMICAL	mg/L		< 5	156	< 5	138	< 5	29
pH		7.0-9.0	8.5	156	8.5	138	8.5	29
RESIDUE, TOTAL NONFILTRABLE	mg/L		3	156	2	138	3	29
RESIDUE, FILTRABLE	mg/L	180	-	-	157	56	157	5
NITROGEN, ORGANIC	mg/L		0.16	156	0.15	138	0.16	294
NITROGEN, AMMONIA	mg/L	0.02	< 0.01	156	< 0.01	138	< 0.01	294
NITROGEN, NITRITE-NITRATE	mg/L		0.25	156	0.26	138	0.26	294
PHOSPHATE, TOTAL	mg/L	0.021	0.027	156	0.023	138	0.025	294
PHOSPHATE, DISSOLVED	mg/L		0.01	156	0.01	138	0.01	294
SODIUM	mg/L		-	-	4.8	56	4.8	56
POTASSIUM	mg/L		-	-	1.4	56	1.4	56
CHLORIDE	mg/L	12.0	9.4	156	9.2	138	9.3	294
SULFATE	mg/L	24.0	22.0	156	21.6	138	21.8	294
SILICA, SiO_2	mg/L		-	-	0.54	56	0.54	56
IRON	μg/L	1000	23	66	16	46	20	112
PHENOL LIKE SUBSTANCES	μg/L	1.0	< 1	92	< 1	24	< 1	116
ASBESTOS	fibers/L X 10^5		-	-	2.47	28	2.47	28
PLATE COUNT, 48 hr.-35° C	per mL		202	156	5	138	110	294
COLIFORM, TOTAL	per 100 mL		16	156	1	138	9	294
COLIFORM, FECAL	per 100 mL geo. mean	20	1.5	156	1.0	137	1.2	293
STREP, FECAL	per 100 mL		1	101	0	26	1	127
FUNGI	per mL		1.9	156	0.9	138	1.4	294
ACTINOMYCETES	per mL		0.5	156	0.2	138	0.4	294
PLANKTON	per mL		2,291	127	1,441	133	1,856	260

City of Chicago Water Purification Division Water Quality Surveillance Section

(1) INCLUDES SOME NORTH SHORE, SOUTH SHORE, JWPP, SWPP STATIONS

(2) INCLUDES SOME NORTH SHORE, SOUTH SHORE, JWPP, SWPP AND ALL OPEN WATER STATIONS

Figure 1. Locations of Lake Survey stations.



The 1984 nearshore annual geometric mean for fecal coliform was 1.5/100 mL, remaining consistent with the 1983 and 1982 annual mean levels of 1.4/100 mL. The 1984 offshore annual geometric mean for fecal coliform was 1.0/100 mL; although this ended three consecutive years of zero counts, the difference was not significant. The all station annual mean for fecal coliform has remained at 1.2/100 mL since 1982. The Illinois Pollution Control Board (IPCB) geometric mean standard for fecal coliform is 20/100 mL with a minimum sampling frequency of at least five samples per 30 day period. Two percent of all the fecal coliform samples in 1984 exceeded the standard.

Ammonia nitrogen concentrations in 1984 for the nearshore and offshore sampling points both averaged less than 0.01 mg/L. The 1984 annual all station mean was also <0.01 mg/L, compared to <0.01 mg/L in 1983 and 0.01 mg/L in 1982. The water quality standard for ammonia nitrogen is 0.02 mg/L. One percent of all the samples collected exceeded the ammonia nitrogen standard.

The total phosphate levels for the nearshore stations in 1984 was 0.027 mg/L as compared to the 1983 annual mean of 0.026 mg/L. Total phosphate mean levels for the offshore stations increased from 0.017 mg/L in 1983 to 0.023 mg/L in 1984. The offshore increases in total phosphate levels were reflected in the all station annual mean of 0.025 mg/L, which exceeded the water quality maximum standard of 0.021 mg/L (equivalent to phosphorous, as P, of 0.007 mg/L). Care should be taken in placing significance on an apparent increase in total phosphate. Laboratory capability for total phosphate is to the hundredths place. Forty-three percent of all the nearshore and offshore samples exceeded the total phosphate standard in 1984 compared to only twenty-four percent in

1983. Differences in sampling dates (seasons) and number of surveys between years may be partially responsible for this increase. Careful monitoring of this parameter is essential, as phosphate is a major factor in the eutrophication of the southwestern portion of Lake Michigan.

The chloride annual mean concentrations for nearshore and offshore sample points in 1984 were 9.4 and 9.2 mg/L, respectively. The all station annual mean for chloride was 9.3 mg/L in 1984, as compared to 10.0 mg/L in 1983. The water quality standard for chloride as promulgated by the IPCB is 12.0 mg/L. One percent of all the samples examined for chloride in 1984 exceeded the standard, as compared to two percent in 1983.

The 1984 sulfate annual mean levels for the nearshore stations decreased by 0.2, from the 1983 mean of 22.2 mg/L. The offshore stations in 1984 increased by 0.1 to 21.6 mg/L. The IPCB water quality standard for sulfate is 24.0 mg/L. The 1984 all station annual mean was 21.8 mg/L, the same as in 1983. One percent of all the nearshore and offshore samples during 1984 exceeded the sulfate standard, down from the three percent in violation in 1983.

Trophic state index values (total phosphorus) were 37.1 for nearshore stations and 31.1 for offshore stations and all stations combined. These values continue to show a substantial improvement in the trophic status of the lake since 1977, with a calculated reduction in algal biomass of 56%.

Daily fecal coliform samples were collected at 58 Illinois Lake Michigan beaches during the swimming season by local agencies. Geometric means ranged from 7/100 mL to 44/100 mL with a median value of 20/100 mL. Forty-seven percent of the beaches exceeded the 20/100 mL water quality standard. Most of the violations were in Lake County and Northern Cook County. In contrast, the swimming criteria (consecutive samples 500/100 mL) was exceeded only once at Ravine Drive, Rosewood, Greenleaf, Pratt/Farwell and Waukegan North beaches and twice at Highland Park beach.

The organochlorine compounds dieldrin (0.001 ug/L) and pentachlorophenol (0.004 ug/L) were detected in very low levels in one of four samples. Total metals concentrations were either below dectable levels or generally within natural levels except for silver. Silver exceeded the general use standard (5.0 ug/L) in one of 24 samples. Cyanide was not detected in any samples.

There continues to be an advisory regarding consumption of Lake Michigan trout and salmon weighing five pounds or more due to toxics contamination.

INTRODUCTION

The Great Lakes system is usually considered to be the largest (95,000 sq.mi.) surface fresh water source in the world, with the exception of the polar ice caps. Lake Michigan is the third largest of all the Great Lakes and it is the largest body of fresh water entirely within the boundaries of the United States.

As a natural resource of immeasurable value, Lake Michigan serves a broad spectrum of purposes. It provides drinking water for an estimated five million residents in the northeastern Illinois area. Its recreational opportunities attract fishing, boating, swimming and water-oriented interests. The lake also serves as an avenue for domestic and international water-borne commerce. Industry and commerce have grown and developed giving the greater Chicago metropolitan area one of the largest industrial-commercial complexes in the United States. Consequently, some of Lake Michigan's water quality problems result from discharges of industrial and municipal wastes.

The City of Chicago has been conducting lake survey monitoring programs since the 1930's which have provided information on the condition of the Illinois waters of Lake Michigan. The number of surveys, parameters and the degree of accuracy in which these analyses are performed has increased greatly over the years. With data gathered on a continuing basis, it has been possible to determine long-term trends in lake water quality. For example, a recent assessment of 1972 vs. 1982 shoreline conditions in Illinois indicated a considerable improvement as a result of a remedial program that diverted several significant discharges from Lake Michigan (ASIWPCA 1983; IEPA 1984).

Recognizing the importance of Lake Michigan as a natural asset, the 75th Illinois General Assembly authorized the Illinois Environmental Protection Agency to "... regularly conduct water quality and lake bed surveys to evaluate the ecology and quality of water in Lake Michigan". Since 1977 the Illinois portion of Lake Michigan is monitored under the terms of a cooperative agreement between the City of Chicago and the Illinois Environmental Protection Agency. This annual report is the product of this joint agreement.

METHODS

The lake survey program is conducted by the City of Chicago's Water Quality Surveillance Section and consists of five separate surveys: the Chicago-Lake Michigan Open Water Survey, the North Shore Lake Survey, the South shore Lake Survey, the JWPP Radial Lake Survey and the SWPP Radial Lake Survey. Since 1977, a typical survey season consists of 20 to 24 survey dates. These surveys are conducted from January through December providing there are no ice problems present.

The lake surveys are conducted from the 85 foot, round hull, 26 gross ton Chicago Water Department tugboat, the James J. Versluis. The water for sampling is drawn through an intake pipe mounted on the portside aft gunnel. The intake orifice is approximately three feet below the water surface and the water samples are collected while the tug is in motion, utilizing a small impeller pump. The water is delivered to a sampling sink tap located within the stern cabin. This arrangement allows the surveys to be conducted during inclement weather, provided lake conditions are not too adverse (e.g. small craft advisories and/or warnings).

The location of sampling stations for the lake survey program are shown in Figure 1. The sample stations are located by a buoy, shore sighting or a timed distance from a fixed point. Three samples are normally collected at each station: an 8 oz. bacterial, an 8 oz. microscopy sample and a gallon chemical sample. Additional samples for cyanide, metals, pesticides, chlorophyll and asbestos analyses are collected from pre-selected stations on the open water and radial surveys. Samples for metals and cyanide are placed in plastic bottles with preservatives. Mercury samples are placed in glass bottles with preservatives. Pesticide samples are placed in specially prepared gallon glass bottles. Chlorophyll are placed in plastic quart bottles wrapped in aluminum foil with preservative. These samples are immediately stored on ice.

Water samples are processed and analyzed mainly by the City of Chicago Water Purification Division Laboratories. Certain selected analyses are performed by both City of Chicago and Illinois Environmental Protection Agency Laboratories. This is part of a quality assurance program and monitoring of the national ambient points as prescribed by the U.S. Environmental Protection Agency.

Survey data are evaluated separately for this annual report. The survey data are also grouped according to nearshore (41 locations less than three miles from shore) and offshore stations (39 locations more than three miles from shore) (Figure 1).

The lake water quality is evaluated on the basis of water quality standards promulgated by the Illinois Pollution Control Board (IPCB) (35 Ill. Adm. Code 302). A description of the parameters along with their applicable standards are provided in the glossary.

SECTION A

OPEN WATER LAKE SURVEY

The Open Water Lake Survey begun in 1977, is intended to assess water quality away from the influence of shore discharges. The data is also used to detect and monitor long-term changes occurring in Lake Michigan and to compare with data obtained from other lake surveys. The Open Water Lake Survey consists of fourteen sampling points located from six to eighteen miles offshore between Evanston, Illinois and Burns Harbor, Indiana (Figure 2).

The 1984 summary of all chemical and microbiological analyses for the four Open Water Surveys are presented in Tables 2 and 3.

Total coliform levels were zero per 100 mL at all the sample stations except stations 9 and 12, which both had a 1984 annual average of 1/100 mL. In 1983, the annual mean was zero per 100 mL at all stations.

The all station annual geometric mean for fecal coliform concentrations remained zero in 1984. These concentrations have consistently been zero since the inception of the Open Water Survey. None of the samples for fecal coliform in 1984 exceeded the IPCB standard of 20/100 mL.

The 1984 ammonia nitrogen all station annual mean based on 56 samples was less than 0.01 mg/L. Eleven of the fourteen individual sample stations showed an annual mean of less than 0.01 mg/L; the remaining three stations were 0.01 mg/L. The IPCB water quality standard for ammonia nitrogen is 0.02 mg/L. Two percent of all the ammonia nitrogen samples on the Open Water Lake Survey were in violation of the standard.

The total phosphate all station annual mean was 0.019 mg/L in 1984 compared to 0.016 mg/L in 1983. Three of the fourteen sample stations on

Table 2. OWS all Station Water Quality Summary, 1984

Parameter	Storet Number	Standard	Samples	Minimum	Maximum	Mean	Standard Deviations	Percent Violations
Turbidity (NTU)	00076		56	0.25	1.30	0.53	0.25	-
Odor, Threshold	00086		56	1	2	1	0.3	-
Conductivity (umhos)	00095		56	265	300	285	6	-
Chemical Oxygen Demand (mg/L)	00335		56	<5	11	<5	<5	-
pH (units)	00400	7.0-9.0	56	8.2	8.6	8.4	0.2	0
Residue,Nonfilterable (mg/L)	00530		56	0	5.0	2.4	0.9	-
Residue,Filterable (mg/L)	00515		56	137	174	157	9.5	-
Organic Nitrogen (mg/L)	00605		56	0.10	0.20	0.14	0.03	-
Ammonia Nitrogen (mg/L)	00610	0.02	56	<0.01	0.03	<0.01	0.01	2
Nitrite-Nitrate Nitrogen(mg/L)	00630		56	0.22	0.30	0.27	0.03	-
Total Phosphate (mg/L)	00650	0.021	56	<0.01	0.06	0.020	0.019	21
Dissolved Phosphate (mg/L)	00653		56	<0.01	0.03	0.01	0.008	-
Sodium (mg/L)	00929		56	4.3	5.4	4.8	0.4	-
Potassium (mg/L)	00937		56	1.2	1.5	1.4	0.1	-
Chloride (mg/L)	00940	12.0	56	8.5	10.5	9.3	0.6	0
Sulfate (mg/L)	00945	24.0	56	20.8	23.8	21.5	0.5	0
Silica (mg/L)	00956		56	0.27	1.05	0.54	0.28	-
Asbestos (fibers/Lx10^5)	00948		28	1.37	3.84	2.47	6.36	-
Plate Count 48 hr.-35°c (No./mL)	31753		56	0	12	2	2.8	-
Total Coliform (No./100 mL)	31503		56	0	2	0	0.4	-
Fecal Coliform (No./100 mL)	31616	20	56	0	0	0(a)	0	0
Fecal Strep (No./100 mL)	31679		-	-	-	-	-	-
Fungi (No./mL)	31856		56	0	2	0.4	0.5	-
Actinomycetes. (No./mL)	80148		56	0	0.9	0.1	0.2	-
Plankton (No./mL)	60050		56	30	2820	818	676	-

City of Chicago Water Purification Division Water Quality Surveillance Section

(a) Geometric Mean

Figure 2. Locations of Open Water Lake Survey stations.

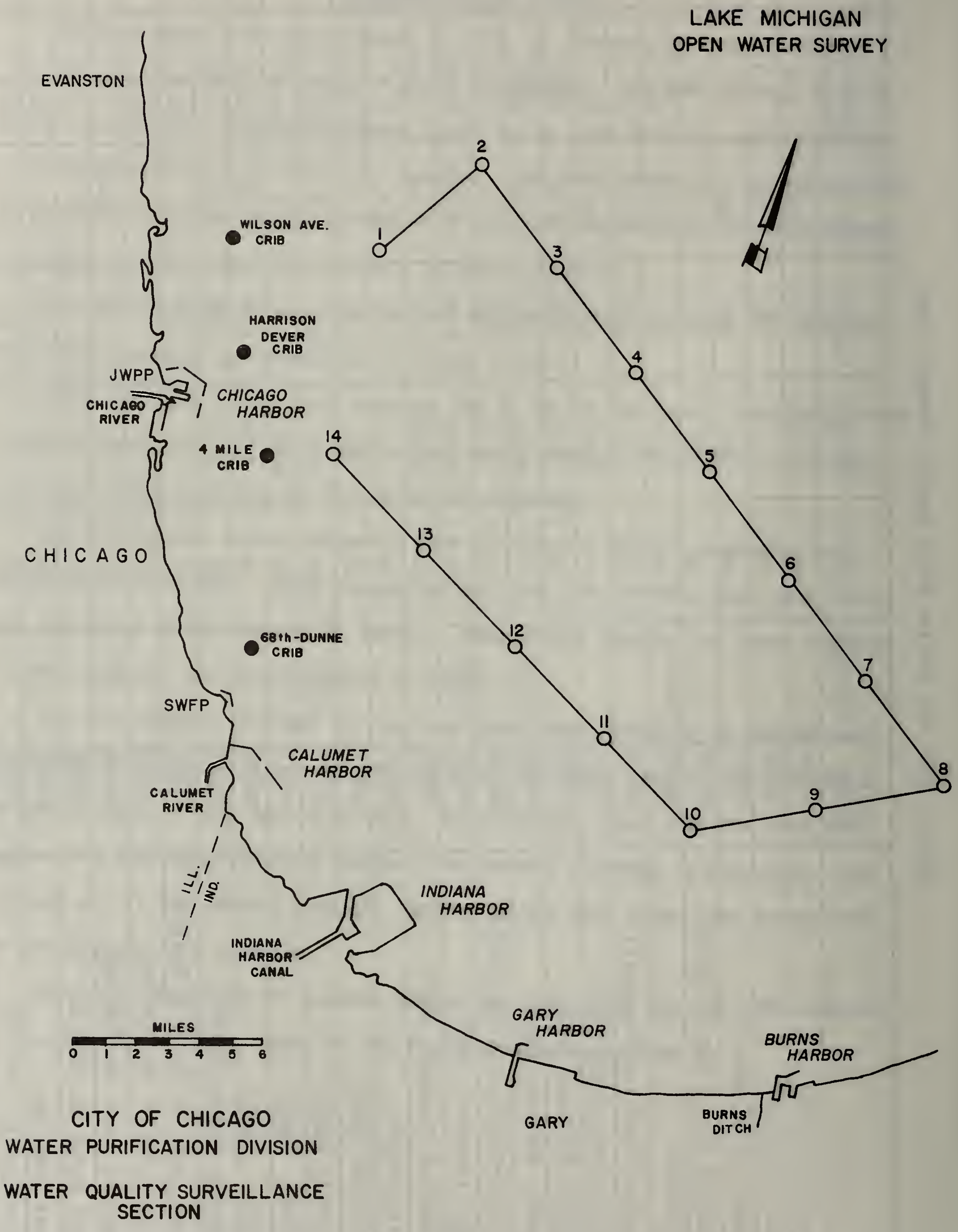


Table 3.

1984
OPEN WATER LAKE SURVEY SUMMARY TABLE

PARAMETER	STORET NUMBER	SUR-VEYS	ANNUAL MEAN													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
TURBIDITY N.T.U.	00076	4	0.74	0.51	0.43	0.41	0.38	0.45	0.50	0.51	0.69	0.56	0.57	0.60	0.49	0.61
ODOR, THRESHOLD T.O.N.	00086	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1
CONDUCTIVITY µmhos	00095	4	276	283	286	285	288	285	288	286	291	289	288	285	281	285
OXYGEN DEMAND, CHEMICAL mg/L	00335	4	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
pH	00400	4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
RESIDUE, TOTAL NONFILTRABLE mg/L	00530	4	4	3	2	3	2	2	3	2	3	3	2	3	2	2
RESIDUE, FILTRABLE mg/L	00515	4	162	158	156	156	151	155	157	159	159	157	157	156	154	155
NITROGEN, ORGANIC mg/L	00605	4	0.14	0.14	0.14	0.13	0.13	0.14	0.13	0.13	0.14	0.14	0.13	0.15	0.14	0.15
NITROGEN, AMMONIA mg/L	00610	4	<0.01	0.01	< 0.01	<0.01	0.01	<0.01	< 0.01	< 0.01	<0.01	< 0.01	<0.01	<0.01	<0.01	0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	4	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
PHOSPHATE, TOTAL mg/L	00650	4	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.02
PHOSPHATE, DISSOLVED mg/L	00653	4	0.01	< 0.01	0.01	0.01	0.01	0.01	< 0.01	0.01	0.01	< 0.01	0.01	0.01	< 0.01	0.01
SODIUM mg/L	00929	4	4.8	4.8	4.7	4.8	4.9	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.7
POTASSIUM mg/L	00937	4	1.4	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
CHLORIDE mg/L	00940	4	9.4	9.3	9.3	9.2	9.2	9.3	9.2	9.2	9.4	9.1	9.2	9.2	9.3	9.4
SULFATE mg/L	00945	4	21.8	21.5	21.8	21.2	21.3	21.4	22.0	21.5	21.4	21.5	21.4	21.4	21.4	21.4
SILICA, SiO_2 mg/L	00956	4	0.59	0.53	0.53	0.56	0.54	0.55	0.52	0.54	0.54	0.52	0.56	0.53	0.54	0.52
ASBESTOS fibers/L X10^5	00948	4	—	1.92	—	1.98	—	2.19	—	2.52	—	2.79	—	2.92	—	2.99
PLATE COUNT, 48hr.-35°C per mL	31753	4	4	3	4	4	2	1	4	2	2	3	3	2	1	1
COLIFORM, TOTAL per 100 mL	31503	4	0	0	0	0	0	0	0	0	1	0	0	1	0	0
COLIFORM, FECAL per 100 mL geo. mean	31616	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STREP, FECAL per 100 mL	31679	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—
FUNGI per mL	31856	4	0.1	0.3	0.2	0.9	1.0	0.2	0.4	1.0	0.3	0.6	0.9	0.4	0.7	0.3
ACTINOMYCETES per mL	80148	4	0	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.2	0.1	0.1	0.1	0.1
PLANKTON per mL	60050	4	1,035	623	705	660	863	938	825	1,073	923	488	1,058	810	825	630

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the Open Water Lake Survey had an annual mean in excess of the IPCB water quality standard of 0.021 mg/L in 1984, as opposed to two stations in 1983. Twenty-one percent of all the open water samples in 1984 exceeded the standard compared to 14% in 1983. Most of the violations (75%) in 1984 were found on December 5.

The chloride annual means for the individual sample stations ranged from 9.1 to 9.4 mg/L. The 1984 all station mean for chloride was 9.3 mg/L, compared to 9.2 mg/L in 1983. None of the 56 open water samples exceeded the IPCB chloride standard of 12.0 mg/L.

The individual station averages for sulfate ranged from 21.2 to 22.0 mg/L, with an all station annual average of 21.5 mg/L, as compared to 21.1 in 1983. None of the samples on the Open Water Survey collected in 1984 exceeded the IPCB standard for sulfate of 24.0 mg/L.

NORTH SHORE LAKE SURVEY

The North Shore Lake Survey consists of ten sampling points located between the City of Chicago's Jardine Water Purification Plant and Waukegan Harbor, Illinois. The ten sampling points, numbered 1N through 11N (point 4N has been dropped), are located from one to four miles offshore (Figure 3).

All sewage treatment plant effluents along the north shore of Illinois have been diverted away from the lake. Factors affecting local water quality include combined sewer overflows, tributary streams, and boat harbors. Remaining discharges along the north shore consist primarily of cooling water.

The 1984 summary of all chemical and microbiological parameters for the six North Shore Surveys are presented in Tables 4 and 5.

Microbiological analyses performed during 1984 indicate a decrease in the number of total coliform. The all station annual arithmetic mean was 6 organisms per 100 mL in 1984, down from 26 organisms in 1983. The annual mean for individual sample stations ranged from one to twenty-four organisms per 100 mL, with three stations reporting zero.

In 1984 the all station annual geometric mean for fecal coliform was one organism per 100 mL. When comparing the 1984 fecal coliform levels along the North Shore with previous years, a continued stable trend between 1 and 2 organisms per 100 mL is noted. Three percent of all the samples in 1984 were in violation of the water quality standard of 20 organisms per 100 mL.

The ammonia nitrogen all station annual mean was less than 0.01 mg/L, below the water quality standard of 0.02 mg/L. All the individual sample stations averaged less than 0.01 mg/L and of the sixty samples collected on the North Shore Surveys during 1984, none were in violation of the IPCB ammonia nitrogen standard.

Figure 3. Locations of North Shore Lake Survey stations.

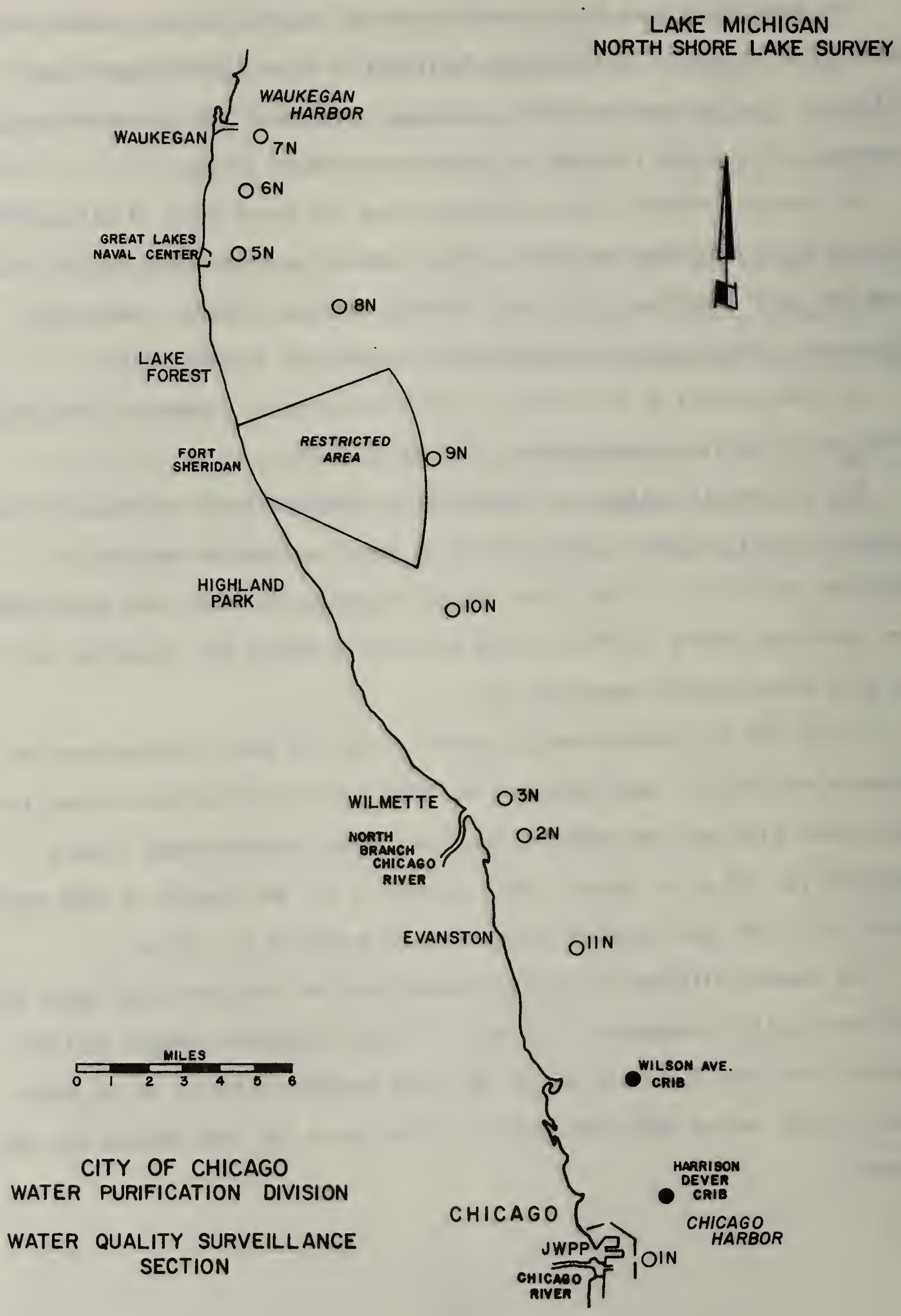

Table 4.

1984
NORTH SHORE LAKE SURVEY SUMMARY TABLE

PARAMETER		STORET NUMBER	SUR-VEYS	ANNUAL MEAN									
				1N	2N	3N	5N	6N	7N	8N	9N	10N	11N
TURBIDITY	N.T.U.	00076	6	1.63	1.08	0.93	1.44	1.51	1.51	0.73	0.77	0.83	1.50
ODOR, THRESHOLD	T.O.N.	00086	6	2	1	1	1	1	1	1	1	1	1
CONDUCTIVITY	μmhos	00095	6	288	288	290	290	292	290	289	289	288	290
OXYGEN DEMAND, CHEMICAL	mg/L	00335	6	<5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
pH		00400	6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
RESIDUE, TOTAL NONFILTRABLE	mg/L	00530	6	2	1	1	1	1	3	2	1	1	2
NITROGEN, ORGANIC	mg/L	00605	6	0.17	0.18	0.17	0.17	0.19	0.16	0.17	0.16	0.17	0.19
NITROGEN, AMMONIA	mg/L	00610	6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
NITROGEN, NITRITE-NITRATE	mg/L	00630	6	0.22	0.25	0.26	0.27	0.27	0.29	0.28	0.27	0.27	0.27
PHOSPHATE, TOTAL	mg/L	00650	6	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02
PHOSPHATE, DISSOLVED	mg/L	00653	6	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CHLORIDE	mg/L	00940	6	9.1	9.0	9.1	9.0	9.1	9.0	8.8	8.7	9.0	9.2
SULFATE	mg/L	00945	6	21.9	21.5	21.7	21.6	21.3	21.5	21.6	21.3	21.7	22.0
PHENOL LIKE SUBSTANCES	μg/L	32730	6	<1	-	< 1	< 1	-	< 1	-	< 1	-	< 1
PLATE COUNT, 48hr. - 35°C	per mL	31753	6	149	8	6	29	26	32	3	4	5	10
COLIFORM, TOTAL	per 100 mL	31503	6	6	1	2	7	16	24	0	0	0	5
COLIFORM, FECAL	per 100 mL geo. mean	31616	6	1.6	0	0	1.6	1.7	1.7	0	0	0	0
STREP, FECAL	per 100 mL	31679	6	1	0	0	0	12	1	0	0	0	0
FUNGI	per mL	31856	6	3.7	2.6	1.4	1.7	1.5	2.7	0.7	1.5	2.3	2.8
ACTINOMYCETES	per mL	80148	6	1.9	0.4	0.5	0.2	0.4	0.1	0.2	0.2	0.4	0.3
PLANKTON	per mL	60050	6	2055	1700	2205	3450	2860	1845	1705	930	1465	2375

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Table 5. NSLS all Station Water Quality Summary, 1984

Parameter	Storet Number	Standard	Samples	Minimum	Maximum	Mean	Standard Deviation	Percent Violation
Turbidity (NTU	00076	-	60	0.30	5.30	1.19	1.13	-
Odor, Threshold (TON)	00086	-	60	1	2	1	0.4	-
Conductivity (umhos)	00095	-	60	270	295	290	6.2	-
Chemical Oxygen Demand (mg/L)	00335	-	60	<5	8	<5	1	-
pH (units)	00400	7.0 - 9.0	60	8.2	8.7	8.5	0.2	0
Residue, Nonfilterable (mg/L)	00530	-	60	0	5	1	1.3	-
Organic Nitrogen (mg/L)	00605	-	60	0.11	0.28	0.17	0.04	-
Ammonia Nitrogen (mg/L)	00610	0.02	60	<0.01	0.01	<0.01	<0.01	0
Nitrite-Nitrate Nitrogen (mg/L)	00630	-	60	0.10	0.34	0.26	0.04	-
Total Phosphate (mg/L)	00650	0.021	60	0.010	0.050	0.025	0.013	43
Dissolved Phosphate (mg/L)	00653	-	60	<0.01	0.04	0.01	0.01	-
Chloride (mg/L)	00940	12.0	60	8.3	10.2	9.0	0.4	0
Sulfate (mg/L)	00945	24.0	60	20.3	22.5	21.6	0.6	0
Phenols (ug/L)	32730	1.0 (a)	36	<1	<1	<1	<1	0
Plate Count 48 hr-35°C (No./mL)	31753	-	60	0	380	27	65	-
Total Coliform (No./100mL)	31503	-	60	0	138	6	22	-
Fecal Coliform (No./100mL)	31616	20	59	0	34	0(b)	2	3
Fecal Strep(No./100mL)	31679	-	40	0	12	1	2	-
Fungi (No./mL)	31856	-	60	0	10	2	3	-
Actinomycetes(No./mL)	80148	-	60	0	8	0.5	1.1	-
Plankton (No./mL)	60050	-	60	0	8910	2059	2414	-

City of Chicago Water Purification Division Water Quality Surveillance Section

(a) Public and Food Processing Water Supply Standard (IPCB,1982)
(b) Geometric Mean

The ten individual station means for total phosphate in 1984 ranged from 0.018 to 0.032 mg/L. The all station annual mean was 0.025 mg/L, down from 0.031 mg/L in 1983. Forty-three percent of the North shore samples exceeded the IPCB total phosphate standard of 0.021 mg/L in 1984 compared to thirty-seven percent in 1983. Most of the violations in 1984 were found on July 17 (35%) and October 17 (27%). Eight of the ten individual station annual means were in violation of the standard; more than half the samples collected at station 1N exceeded the standard.

The chloride values for the North Shore Lake Survey stations in 1984 ranged from 8.7 to 9.2 mg/L. The all station annual mean for 1984 was 9.0 mg/L, compared to 10.1 in 1983. None of North Shore Lake Survey samples exceeded the IPCB water quality standard for chloride (12.0 mg/L) in 1984, compared to three percent in 1983.

The annual mean of individual sample points for sulfate ranged from 21.3 to 22.0 mg/L. The all station annual mean for sulfate in 1984 was 21.6 mg/L, compared to 21.9 in 1983. The water quality standard for sulfate is 24.0 mg/L. None of the sulfate samples on the NSLS were in violation of the standard, compared to two percent in 1983.

SOUTH SHORE LAKE SURVEY

The South Shore Lake Survey consists of 11 sample points numbered 1S through 11S located between Chicago's Burnham Harbor and Burns Harbor, Indiana, east of Gary. Points 1S through 7S are within one mile of shore and are affected by shore discharges. Points 8S through 11S are from two to six miles offshore and monitor indirect effects of these discharges on the lake proper (Figure 4).

The shoreline covered by this survey includes about twenty miles of the most concentrated industrial area in the nation, consisting predominately of petroleum refining and steel manufacturing. In Indiana, the Indiana Harbor Canal, the Calumet River and Burns Ditch are the recipients of large amounts of industrial wastes and treated wastewater, and discharge directly into the lake. These are the three primary sources affecting water quality along the south shore.

Since over 90% of the water in the Indiana Harbor Canal originates as treated wastewater, cooling water and storm water overflow from sewers, it is considered to be the main source of pollution in the southwestern basin of Lake Michigan (Indiana Stream Pollution Control Board, 1973). The effluents from steel mills, oil refineries and municipal sewage treatment plants often result in a plume of polluted water which flows from the harbor, causing occasional periods of degraded water quality at Chicago's South Water Purification Plant. This in turn requires additional cost for taste and odor removal and treatment processing.

The Calumet River and the Grand Calumet River usually flow inland, but may flow into the lake during periods of heavy precipitation. Flow at the mouth of the Calumet River is lakeward due to nearby discharges. The outward flow carries polluted Calumet Harbor water into the southern end of Lake Michigan, which has neither sufficient depth nor currents necessary to absorb and dilute the wastes.

Table 6.. SSLS all Station Water Quality Summary, 1984

Parameter	Storet Number	Standard	Samples	Minimum	Maximum	Mean	Standard Deviation	Percent Violation
Turbidity (NTU)	00076		66	0.30	11.0	2.23	2.6	-
Odor, Threshold (TON)	00086		66	1	2	1	0.4	-
Conductivity (umhos)	00095		66	250	325	287	12.6	-
Chemical Oxygen Demand (mg/L)	00335		66	<5	7.8	<5	3.1	-
pH (units)	00400	7.0 - 9.0	66	8.2	8.7	8.6	0.1	0
Residue, Nonfilterable (mg/L)	00530		66	0	18	3.3	4.1	-
Organic Nitrogen (mg/L)	00605		66	0.12	0.20	0.16	0.02	-
Ammonia Nitrogen (mg/L)	00610	0.02	66	<0.01	0.08	<0.01	0.01	3
Nitrite-Nitrate Nitrogen (mg/L)	00630		66	0.19	0.44	0.28	0.05	-
Total Phosphate (mg/L)	00650	0.021	66	<0.01	0.06	0.026	0.014	55
Dissolved Phosphate (mg/L)	00653		66	<0.01	0.05	0.01	0.01	-
Chloride (mg/L)	00940	12.0	66	8.0	13.0	9.5	0.9	5
Sulfate (mg/L)	00945	24.0	66	20.0	25.0	22.0	1.2	6
Phenols (ug/L)	32730	1.0 (a)	66	<1	<1	<1	0	0
Plate Count 48 hr-35°C (No./mL)	31753		66	0	23000	451	2827	-
Total Coliform (No./100mL)	31503		66	0	344	33	75	-
Fecal Coliform (No./100mL)	31616	20	66	0	122	1.7 (b)	3	6
Fecal Strep(No./100mL)	31679		66	0	22	1	2.7	-
Fungi (No./mL)	31856		66	0	17	2.1	3.5	-
Actinomycetes(No./mL)	80148		66	0	5	0.6	0.9	-
Plankton (No./mL)	60050		55	30	8250	1789	2172	-

City of Chicago Water Purification Division Water Quality Surveillance Section

(a) Public and Food Processing Water Supply Standard (IPCB,1982)
(b) Geometric Mean

Figure 4. Locations of South Shore Lake Survey stations.

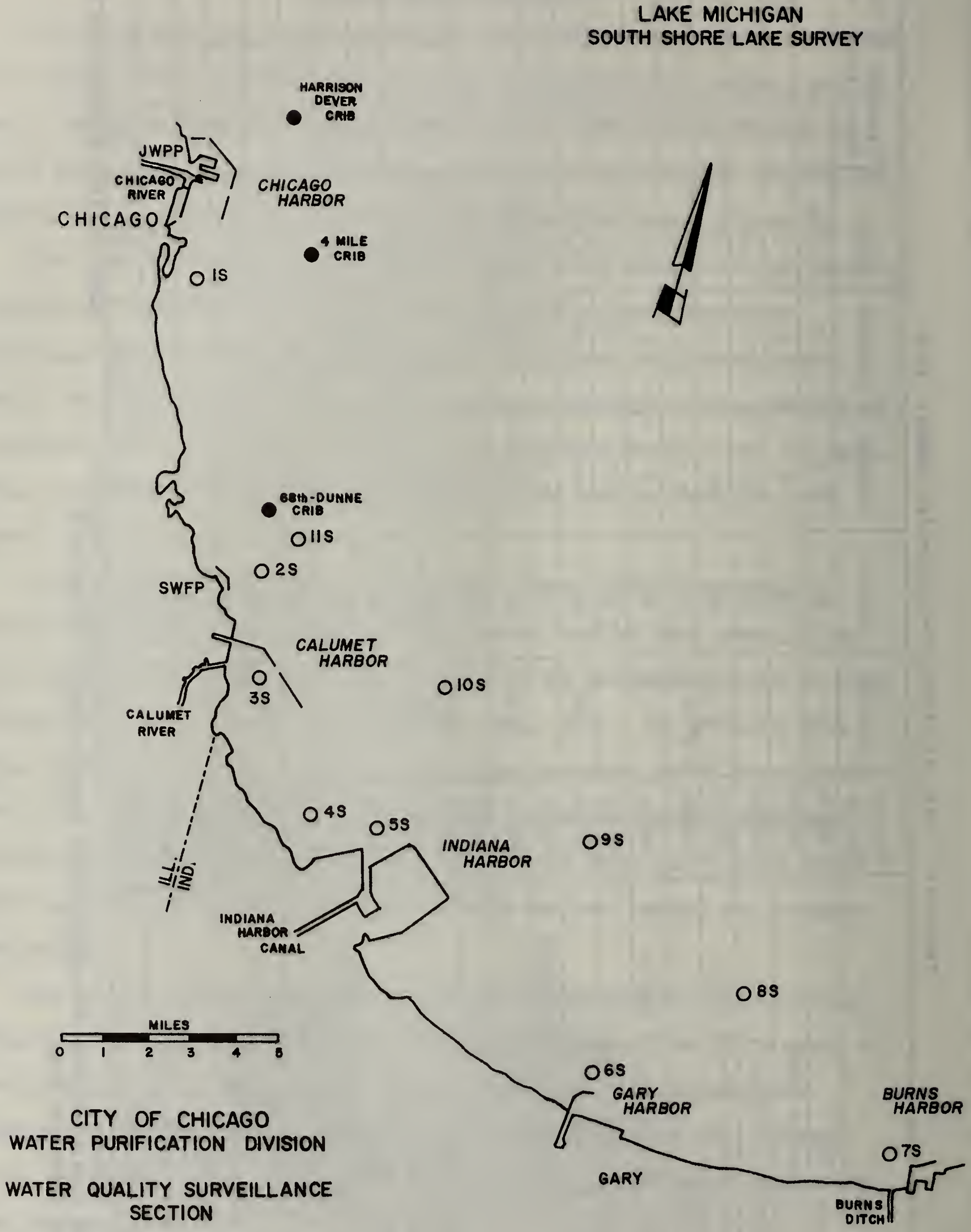

Table 7.

1984
SOUTH SHORE LAKE SURVEY SUMMARY TABLE

PARAMETER		STORET NUMBER	SURVEYS	ANNUAL MEAN										
				1S	2S	3S	4S	5S	6S	7S	8S	9S	10S	11S
TURBIDITY	N.T.U.	00076	6	2.91	2.94	3.30	3.52	2.68	2.01	1.82	1.25	1.53	1.22	1.42
ODOR, THRESHOLD	T.O.N.	00086	6	1	2	1	2	2	1	1	1	1	1	1
CONDUCTIVITY	µmhos	00095	6	286	289	294	297	298	288	285	279	285	280	281
OXYGEN DEMAND, CHEMICAL	mg/L	00335	6	< 5	< 5	< 5	< 5	< 5	< 5	<5	<5	< 5	<5	< 5
pH		00400	6	8.5	8.6	8.6	8.6	8.5	8.6	8.6	8.6	8.6	8.6	8.6
RESIDUE, TOTAL NONFILTRABLE	mg/L	00530	6	5	4	4	5	4	3	3	2	2	2	2
NITROGEN, ORGANIC	mg/L	00605	6	0.16	0.16	0.17	0.16	0.17	0.17	0.17	0.16	0.15	0.16	0.16
NITROGEN, AMMONIA	mg/L	00610	6	0.01	< 0.01	0.01	< 0.01	0.02	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
NITROGEN, NITRITE-NITRATE	mg/L	00630	6	0.27	0.27	0.28	0.29	0.31	0.27	0.28	0.26	0.27	0.26	0.26
PHOSPHATE, TOTAL	mg/L	00650	6	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
PHOSPHATE, DISSOLVED	mg/L	00653	6	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
CHLORIDE	mg/L	00940	6	9.3	9.5	9.9	10.1	10.6	9.4	9.4	8.9	9.5	9.4	9.0
SULFATE	mg/L	00945	6	21.9	21.8	22.6	22.8	23.2	21.9	22.2	21.4	21.8	21.6	21.5
PHENOL LIKE SUBSTANCES	µg/L	32730	6	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
PLATE COUNT, 48hr.-35°C	per mL	31753	6	36	51	102	344	4,102	46	207	6	24	27	11
COLIFORM, TOTAL	per 100 mL	31503	6	2	7	12	84	151	10	80	2	13	1	1
COLIFORM, FECAL	per 100 mL geo. mean	31616	6	0	0	2.1	3.0	9.4	0	2.4	0	0	0	0
STREP, FECAL	per 100mL	31679	6	0	0	1	4	0	0	0	0	0	0	0
FUNGI	per mL	31856	6	2.7	2.7	2.7	1.8	2.2	2.2	2.5	1.3	2.9	1.2	1.2
ACTINOMYCETES	per mL	80148	6	1.2	0.6	1.3	0.7	0.6	0.6	1.0	0.3	0.2	0.1	0.6
PLANKTON	per mL	60050	6	1,710	1,710	1,842	1,890	2,130	2,040	1,524	1,884	1,584	1,512	1,854

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In Indiana, the Little Calumet River receives large volumes of sewer discharges and flows into Burns Ditch. Burns Ditch flows into Lake Michigan in the vicinity of Burns Harbor.

All chemical and micorbiological analyses for the six South Shore Lake Surveys performed during 1984 are presented in Tables 6 and 7.

As observed in previous years, the highest bacterial concentrations were found at points 3S through 7S along the Calumet, Indiana, Gary and Burns Harbor areas. On the South Shore Lake Survey (SSLS) in 1984, sample points 3S through 7S contributed 93% of the total coliform counts, with 4S and 5S accounting 65%. These continually high nearshore values indicate the pollution load from the industrial complexes in this area.

Microbiological analyses performed during 1984 indicate an increase in the number of total coliform from those in 1983. The 1984 all station annual mean was 33 organisms per 100 mL, up from 3 in 1983. Although the total coliform mean level increased in 1984, it is still well below all the annual mean levels prior to 1983.

The 1984 all station geometric mean for fecal coliform was 1.7 per 100 mL, up slightly from 1.2/100 mL in 1983, but still well below the geometric mean IPCB water quality standard of 20/100 mL. Fecal coliform annual means for individual stations ranged from zero to 9.4/100 mL. Six percent of all the SSLS samples exceeded the water quality standard.

The all station annual mean value for ammonia nitrogen in 1984 was <0.01 mg/L,compared to 0.01 mg/L in 1983. None of the station annual averages were in violation of the 0.02 mg/L water quality standard. Three percent of all the SSLS samples in 1984 exceeded the ammonia nitrogen standard compared to five percent in 1983.

The all station annual mean for total phosphate was 0.026 mg/L in 1984, the same as in 1983, still exceeding the Illinois Pollution Control Board water quality standard of 0.021 mg/L. All but two of the individual station averages for total phosphate in 1984 were in violation of the standard. Fifty-five percent of all the South Shore Survey samples collected in 1984 were in violation of the water quality standard, compared to 33% in 1983, and 34% in 1982. Forty-four percent of the violations in 1984 were found in August (8/7 & 8/21).

The all station annual mean for chloride in 1984 was 9.5 mg/L, below the mean level of 10.2 mg/L in 1983. The annual mean value for each of the eleven stations was below the water quality standard of 12.0 mg/L. Five percent of all the SSLS samples collected in 1984 were in violation of the chloride standard.

The sulfate annual mean for individual sample points ranged from 21.4 to 23.2 mg/L. The all station annual mean for 1984 was 22.0 mg/L, compared to 21.9 mg/L in 1983. The IPCB water quality standard for sulfate is 24.0 mg/L. Six percent of all the SSLS samples in 1984 were in violation of the standard. The number of samples in violation of the standard in 1983 was nine percent.

In reviewing the chemical and microbiological data of the SSLS, especially from sample points 4S and 5S, it appears that the Indiana Harbor Canal delivers the highest pollution load to the southwestern basin of Lake Michigan. The mean value of point 5S was higher or equal to the mean value for all the sample points during 1984 for total coliform, fecal coliform, ammonia nitrogen, chloride and sulfate.

JARDINE WATER PURIFICATION PLANT RADIAL LAKE SURVEY

The JWPP Radial Lake Survey consists of 23 sample stations located along five radii projecting out from an axis point at the Chicago Harbor Lighthouse, just east of the Jardine Water Purification Plant (Figure 5). This survey is intended to assess the water quality within a ten mile radius of the Jardine Water Purification Plant.

The 1984 summary of all chemical and microbiological analyses for the two JWPP Radial Surveys are presented in Tables 8 and 9.

Average total coliform bacterial levels in 1984 indicate water of good quality. Station averages for total coliform ranged from zero to five per 100 mL, with fifteen stations reporting zero. The all station annual arithmetic mean was one organism per 100 mL in 1984, the same as in 1983. Since 1980 the JWPP all station annual mean levels have ranged from one to three organisms per 100 mL indicating good water quality.

The individual station annual geometric mean for fecal coliform in 1984 was zero at twenty-one of the twenty-three sample stations. The remaining two stations reported one organism per 100 mL. The IPCB water quality geometric mean standard for fecal coliform is 20/100 mL. None of the JWPP Radial samples exceeded the standard in 1984 or 1983.

The individual station mean values for ammonia nitrogen were all <0.01 mg/L. As in 1983, the 1984 all station annual mean was <0.01 mg/L, since all the samples collected on each of the two radial surveys were less than 0.01 mg/L. The IPCB water quality standard for ammonia nitrogen is 0.02 mg/L.

Station averages for total phosphate concentrations on the two surveys in 1984 ranged from 0.020 to 0.050 mg/L. The all station average was 0.032 mg/L

Table 8. JWPP Radial all Station Water Quality Summary, 1984

Parameter	Storet Number	Standard	Samples	Minimum	Maximum	Mean	Standard Deviation	Percent Violation
Turbidity (NTU)	00076		46	0.20	4.00	1.14	0.96	-
Odor, Threshold (TON)	00086		46	1	2	1	0.03	-
Conductivity (umhos)	00095		46	270	290	285	4.5	-
Chemical Oxygen Demand (mg/L)	00335		46	<5	5.1	<5	<5	0
pH (units)	00400	7.0 - 9.0	46	8.0	8.6	8.5	0.1	-
Residue, Nonfilterable (mg/L)	00530		46	0	8	3	2.6	-
Organic Nitrogen (mg/L)	00605		46	0.12	0.22	0.15	0.03	-
Ammonia Nitrogen (mg/L)	00610	0.02	46	<0.01	<0.01	<0.01	<0.01	0
Nitrite-Nitrate Nitrogen (mg/L)	00630		46	0.03	0.28	0.26	0.05	-
Total Phosphate (mg/L)	00650	0.021	46	0.01	0.08	0.032	0.016	59
Dissolved Phosphate (mg/L)	00653		46	<0.01	0.05	0.02	0.01	-
Chloride (mg/L)	00940	12.0	46	8.0	12.0	9.7	1.25	0
Sulfate (mg/L)	00945	24.0	46	21.0	22.0	21.3	0.25	0
Phenols (ug/L)	32730	1.0(b)	0	-	-	-	-	-
Iron (ug/L)	01045	1000(a)	46	<10	100	19	20.9	0
Plate Count 48 hr-35°C (No./mL)	31753		46	0	25	3	5.6	-
Total Coliform (No./100mL)	31503		46	0	8	1	1.4	-
Fecal Coliform (No./100mL)	31616	20	46	0	4	0(c)	1.4	0
Fecal Strep (No./100mL)	31679		0	-	-	-	-	-
Fungi (No./mL)	31856		46	0	3	0.9	1.05	-
Actinomycetes (No./mL)	80148		46	0	1.1	0.2	0.3	-
Plankton (No./mL)	60050		35	60	9990	3269	3539	-

City of Chicago Water Purification Division Water Quality Surveillance Section

(a) General Use Standard (IPCB,1982)
(b) Public and Food Processing Water Supply Standard (IPCB,1982)
(c) Geometric Mean

Figure 5. Locations of Jardine Water Purification Plant Radial Survey stations

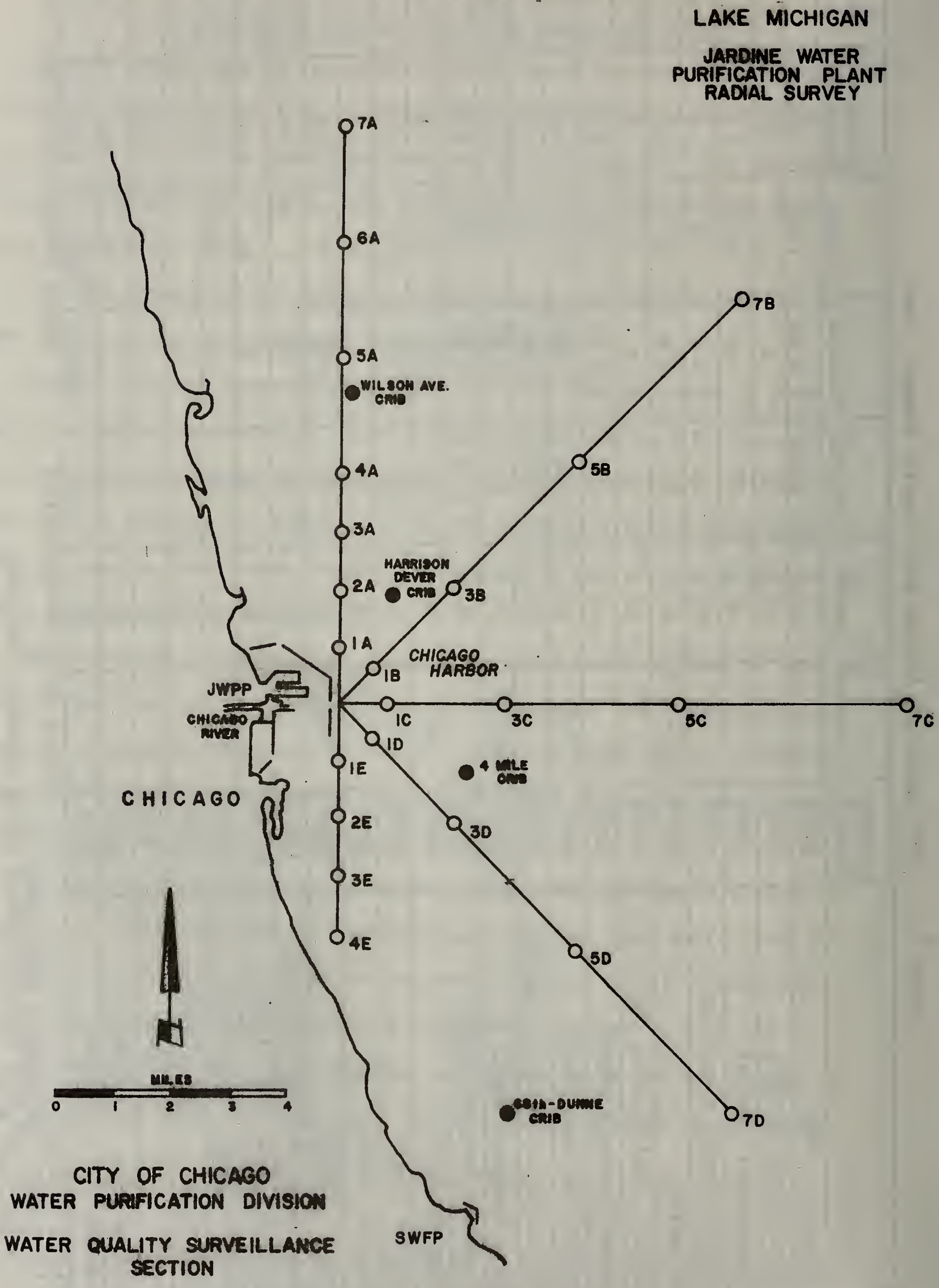


Table 9.

1984
JWPP RADIAL LAKE SURVEY SUMMARY TABLE

PARAMETER		STORET NUMBER	SUR-VEYS	ANNUAL MEAN										
				1A	2A	3A	4A	5A	6A	7A	1B	3B	5B	7B
TURBIDITY	N.T.U.	00076	2	1.50	1.25	1.05	1.00	1.05	0.65	0.65	1.63	0.60	0.53	0.70
ODOR, THRESHOLD	T.O.N.	00086	2	2	2	2	1	1	1	1	1	1	1	1
CONDUCTIVITY	µmhos	00095	2	278	288	283	285	288	288	288	288	283	283	278
OXYGEN DEMAND, CHEMICAL	mg/L	00335	2	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
pH		00400	2	8.3	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
RESIDUE, TOTAL NONFILTRABLE	mg/L	00530	2	1	4	2	3	3	2	2	3	3	2	2
NITROGEN, ORGANIC	mg/L	00605	2	0.15	0.15	0.15	0.15	0.15	0.15	0.13	0.15	0.16	0.13	0.15
NITROGEN, AMMONIA	mg/L	00610	2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
NITROGEN, NITRITE - NITRATE	mg/L	00630	2	0.16	0.23	0.27	0.26	0.27	0.24	0.27	0.26	0.27	0.27	0.27
PHOSPHATE, TOTAL	mg/L	00650	2	0.05	0.03	0.03	0.05	0.03	0.03	0.03	0.03	0.03	0.04	0.04
PHOSPHATE, DISSOLVED	mg/L	00653	2	0.03	0.03	0.01	0.01	0.02	0.02	0.03	0.03	0.02	0.02	0.02
CHLORIDE	mg/L	00940	2	10.3	10.5	10.8	10.3	10.3	10.5	10.5	10.3	10.2	10.2	10.1
SULFATE	mg/L	00945	2	21.4	21.2	21.3	21.4	21.4	21.3	21.4	21.2	21.3	21.7	21.0
PHENOL LIKE SUBSTANCES	µg/L	32730	0	-	-	-	-	-	-	-	-	-	-	-
IRON	µg/L	01045	2	23	18	< 10	10	18	10	10	23	13	13	10
PLATE COUNT, 48 HR. - 35°C	per mL	31753	2	14	9	5	5	3	1	2	11	1	1	1
COLIFORM, TOTAL	per 100 mL	31503	2	5	0	1	0	2	0	0	0	0	0	0
COLIFORM, FECAL	per 100 mL geo. mean	31616	2	0	0	0	0	0	0	0	0	0	0	0
STREP, FECAL	per 100 mL	31679	0	-	-	-	-	-	-	-	-	-	-	-
FUNGI	per mL	31856	2	2.0	1.1	1.6	1.5	0.5	1.5	0.5	0.5	0.5	0.5	1.5
ACTINOMYCETES	per mL	80148	2	0.45	0.30	0.65	0.15	0.60	0.20	0.05	0.20	0.05	0.03	0.15
PLANKTON	per mL	60050	2	1,665	-	2,100	-	4,455	-	3,930	60	1,770	2,925	1,905

Table 9.

1984
JWPP RADIAL LAKE SURVEY SUMMARY (cont'd)

PARAMETER	STORET NUMBER	SUR-VEYS	ANNUAL MEAN											
			1C	3C	5C	7C	1D	3D	5D	7D	1E	2E	3E	4E
TURBIDITY N.T.U.	00076	2	1.60	0.58	0.55	0.45	2.10	0.68	0.68	0.53	2.30	2.50	1.90	1.70
ODOR, THRESHOLD T.O.N.	00086	2	1	1	1	1	1	1	1	1	1	1	1	1
CONDUCTIVITY µmhos	00095	2	285	285	285	285	285	283	283	285	290	285	290	290
OXYGEN DEMAND, CHEMICAL mg/L	00335	2	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	<5	<5	< 5	< 5
pH	00400	2	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
RESIDUE, TOTAL NONFILTRABLE mg/L	00530	2	4	2	3	3	4	2	3	2	4	4	5	4
NITROGEN, ORGANIC mg/L	00605	2	0.13	0.17	0.15	0.13	0.17	0.17	0.15	0.18	0.17	0.16	0.15	0.18
NITROGEN, AMMONIA mg/L	00610	2	<0.01	< 0.01	<0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NITROGEN, NITRITE - NITRATE mg/L	00630	2	0.27	0.27	0.27	0.28	0.27	0.28	0.27	0.27	0.15	0.27	0.27	0.27
PHOSPHATE, TOTAL mg/L	00650	2	0.03	0.03	0.03	0.04	0.05	0.03	0.02	0.03	0.04	0.03	0.04	0.04
PHOSPHATE, DISSOLVED mg/L	00653	2	0.01	0.01	0.03	0.03	0.03	0.01	0.02	0.01	0.04	0.02	0.03	0.03
CHLORIDE mg/L	00940	2	10.2	9.0	8.9	8.6	8.6	8.4	8.7	8.6	9.8	10.0	8.8	10.1
SULFATE mg/L	00945	2	21.3	21.2	21.0	21.3	21.4	21.4	21.4	21.5	21.4	21.5	21.7	21.3
PHENOL LIKE SUBSTANCES µg/L	32730	0	-	-	-	-	-	-	-	-	-	-	-	-
IRON µg/L	01045	2	28	< 10	13	15	10	13	10	15	23	28	60	78
PLATE COUNT, 48 HR. - 35°C per mL	31753	2	10	0	1	1	5	1	0	0	1	8	1	2
COLIFORM, TOTAL per 100mL	31503	2	1	0	0	0	1	0	0	0	0	1	1	1
COLIFORM, FECAL per 100 mL geo. mean	31616	2	1	0	0	0	1	0	0	0	0	0	0	0
STREP, FECAL per 100 mL	31679	0	-	-	-	-	-	-	-	-	-	-	-	-
FUNGI per mL	31856	2	0.5	0.5	0.5	1.0	1.0	0.0	0.0	0.5	1.0	1.0	1.5	0.5
ACTINOMYCETES per mL	80148	2	0.3	0.2	0.1	0.4	0.1	0.2	0.0	0.3	0.2	0.0	0.1	0.0
PLANKTON per mL	60050	2	4,455	4,110	3,045	2,475	3,960	5,120	4,200	4,410	4,335	-	2,325	-

compared to 0.020 mg/L in 1983 and 0.027 mg/L in 1982 and in excess of the water quality standard for total phosphate of 0.021 mg/L. Fifty-nine percent of the JWPP Radial Survey samples exceeded the Lake Michigan standard in 1984, compared to twenty-six percent in violation in 1983, and 51% in 1982. Most of the violations (81%) in 1984 were found on July 31.

The 1984 individual station averages for chloride ranged from 8.4 to 10.8 mg/L, with an all station annual average of 9.7 mg/L, compared to 10.5 mg/L in 1983. The Lake Michigan water quality standard for chloride is 12.0 mg/L. None of the samples collected on the two radial surveys in 1984 were in violation of the standard, as compared to seven percent in 1983.

Individual station averages for sulfate ranged from 21.0 to 21.7 mg/L. The annual arithmetic mean for all 46 observations was 21.3 mg/L in 1984, down from 22.7 mg/L in 1983. None of the samples in 1984 exceeded the IPCB water quality standard for sulfate of 24.0 mg/L, compared to four percent of the JWPP samples collected in 1983.

SOUTH WATER PURIFICATION PLANT RADIAL LAKE SURVEY

The SWPP Radial Lake Survey consists of 22 sample stations located along five radii projecting out from an axis point near the South Water Purification Plant (Figure 6). The purpose of the survey is to assess the water quality within a ten mile radius of the South Water Purification Plant.

Water quality within the survey area is largely determined by the action of discharges from the Calumet-Indiana industrial area. Meterological conditions determine to what extent the Indiana Harbor Canal and other shore discharges will flow into the survey area. Radii "J" and "F" usually exhibit higher average bacterial and chemical levels than the other radii due to their close proximity to these discharges. A summary of all chemical and microbiological analyses on the three SWPP Radial Lake Surveys in 1984 is presented in Tables 10 and 11.

The individual sample stations had total coliform annual mean levels ranging from 1 to 7 organisms per 100 mL, with ten of the twenty-two stations reporting zero. The all station annual arithmetic mean for total coliform was one organism per 100 mL in 1984 indicating good quality water.

Fecal coliform geometric mean levels for the individual sampling stations in 1984 were zero at twenty of the twenty-two stations. The IPCB fecal coliform standard is 20/100 mL. Excellent water quality is exhibited with an all station annual geometric mean of zero fecal coliform.

All twenty-two sample stations on each of the SWPP Radial Lake Surveys exhibited excellent water quality with ammonia nitrogen annual mean levels of 0.01 mg/L. The all station annual arithmetic mean for ammonia nitrogen was 0.01 mg/L in 1984, below the 0.01 mg/L in 1983 and also below the IPCB water quality standard of 0.02 mg/L.

Table 10. SWPP Radial all Station Water Quality Summary, 1984

Parameter	Storet Number	Standard	Samples	Minimum	Maximum	Mean	Standard Deviation	Percent Violation
Turbidity (NTU)	00076		66	0.30	1.80	0.88	0.41	-
Odor, Threshold (TON)	00086		66	1	2	1	0.36	-
Conductivity (umhos)	00095		66	270	295	283	7.7	-
Chemical Oxygen Demand (mg/L)	00335		66	<5	8.4	<5	2.0	-
pH (units)	00400	7.0 - 9.0	66	8.2	8.6	8.5	0.09	0
Residue, Nonfilterable (mg/L)	00530		66	1	8	3	2.5	-
Organic Nitrogen (mg/L)	00605		66	0.12	0.23	0.16	0.03	-
Ammonia Nitrogen (mg/L)	00610	0.02	66	<0.01	0.01	<0.01	<0.01	0
Nitrite-Nitrate Nitrogen (mg/L)	00630		66	0.00	0.30	0.22	0.06	-
Total Phosphate (mg/L)	00650	0.021	66	<0.01	0.08	0.024	0.02	36
Dissolved Phosphate (mg/L)	00653		66	<0.01	0.06	0.02	0.02	-
Chloride (mg/L)	00940	12.0	66	7.5	10.7	9.1	0.7	0
Sulfate (mg/L)	00945	24.0	66	21.3	24.0	22.4	0.7	0
Phenols (ug/L)	32730	1.0(b)	14	<1	<1	<1	0	0
Iron (ug/L)	01045	1000(a)	66	<10	73	21	17.5	0
Plate Count 48 hr-35°C (No./mL)	31753		66	0	130	8	19.9	-
Total Coliform (No./100mL)	31503		66	0	20	1	2.8	-
Fecal Coliform (No./100mL)	31616	20	66	0	24	0(c)	1.6	2
Fecal Strep (No./100mL)	31679		21	0	0	0	0	-
Fungi (No./mL)	31856		66	0	8.0	1.4	1.7	-
Actinomycetes (No./mL)	80148		66	0	1.1	0.3	0.3	-
Plankton (No./mL)	60050		54	0	7530	1858	1900	-

City of Chicago Water Purification Division Water Quality Surveillance Section

(a) General Use Standard (IPCB,1982)
(b) Public and Food Processing Water Supply Standard (IPCB,1982)
(c) Geometric Mean

Figure 6. Location of South Water Filtration Plant Radial Survey stations.

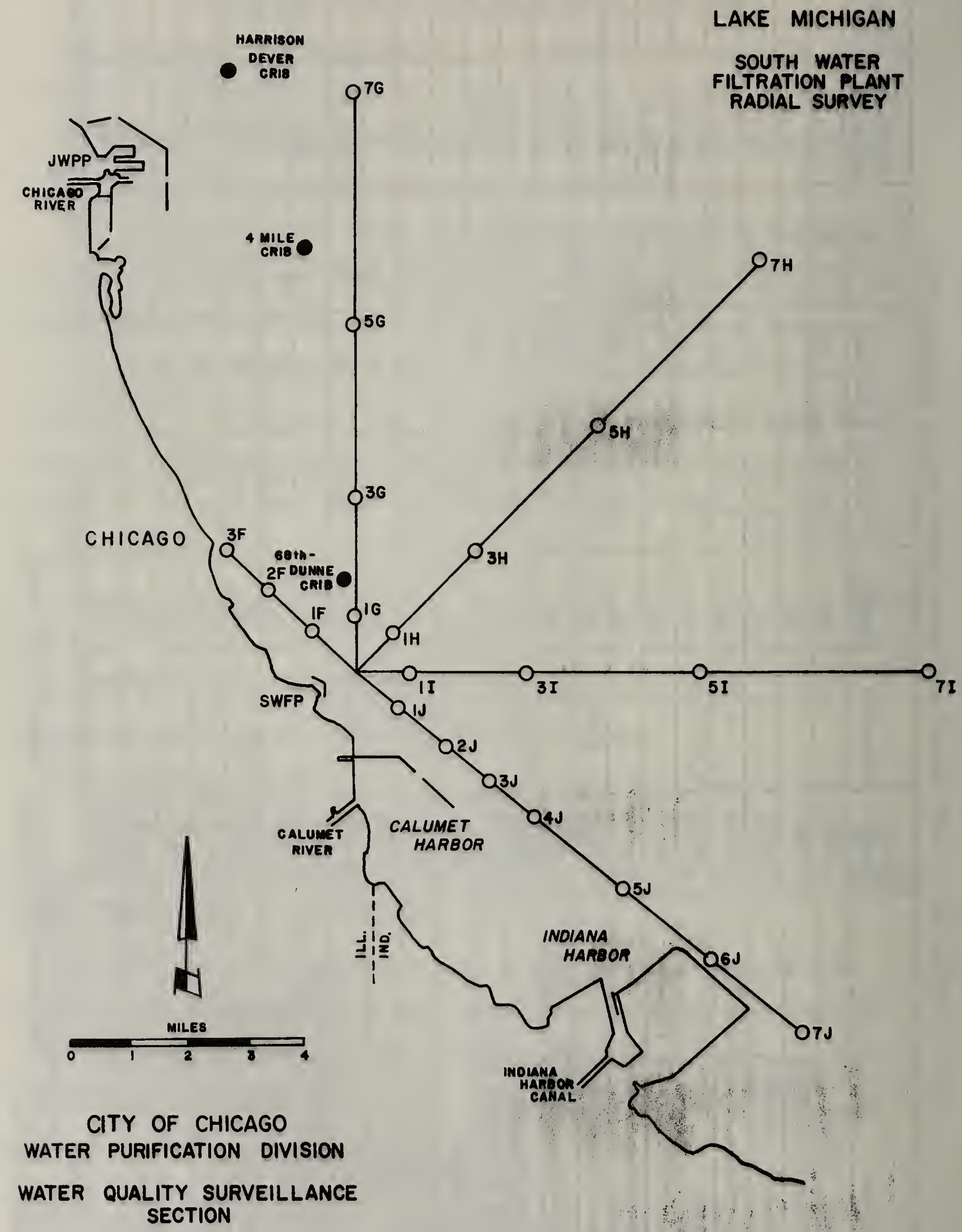


Table 11.

1984
SWPP RADIAL LAKE SURVEY SUMMARY TABLE

PARAMETER		STORET NUMBER	SUR-VEYS	ANNUAL MEAN										
				1F	2F	3F	1G	3G	5G	7G	1H	3H	5H	7H
TURBIDITY	N.T.U.	00076	3	1.17	1.03	1.13	0.93	0.83	0.75	0.70	0.95	0.80	0.70	0.53
ODOR, THRESHOLD	T.O.N.	00086	3	1	1	1	1	1	1	1	1	1	1	1
CONDUCTIVITY	µmhos	00095	3	287	285	285	287	287	285	282	287	283	283	282
OXYGEN DEMAND, CHEMICAL	mg/L	00335	3	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
pH		00400	3	8.4	8.5	8.5	8.5	8.5	8.4	8.5	8.5	8.5	8.5	8.5
RESIDUE, TOTAL NONFILTRABLE	mg/L	00530	3	4	4	4	4	3	3	3	4	3	3	3
NITROGEN, ORGANIC	mg/L	00605	3	0.16	0.18	0.14	0.14	0.17	0.16	0.14	0.14	0.16	0.16	0.16
NITROGEN, AMMONIA	mg/L	00610	3	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
NITROGEN, NITRITE - NITRATE	mg/L	00630	3	0.14	0.19	0.22	0.24	0.24	0.17	0.16	0.23	0.25	0.25	0.18
PHOSPHATE, TOTAL	mg/L	00650	3	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.03
PHOSPHATE, DISSOLVED	mg/L	00653	3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CHLORIDE	mg/L	00940	3	9.2	8.9	9.2	9.1	9.2	9.1	8.7	8.9	9.2	8.6	8.3
SULFATE	mg/L	00945	3	22.0	22.3	22.5	22.2	22.4	22.7	22.3	22.3	22.2	22.0	22.3
PHENOL LIKE SUBSTANCES	µg/L	32730	0	-	-	-	-	-	-	-	-	-	-	-
IRON	µg/L	01045	3	18	13	16	20	12	17	29	25	23	22	13
PLATE COUNT, 48 HR. - 35°C	per mL	31753	3	4	6	6	9	9	5	8	5	4	2	4
COLIFORM TOTAL	per 100 mL	31503	3	7	1	2	1	0	0	1	1	1	0	0
COLIFORM, FECAL	per 100 mL geo. mean	31616	3	2	0	0	0	0	0	0	0	0	0	0
STREP, FECAL	per 100 mL	31679	0	-	-	-	-	-	-	-	-	-	-	-
FUNGI	per mL	31856	3	4.1	2.3	2.3	1.0	0.3	2.7	1.0	1.4	1.3	0.3	0.7
ACTINOMYCETES	per mL	80148	3	0.2	0.4	0.5	0.5	0.2	0.6	0.5	0.2	0.2	0.2	0.2
PLANKTON	per mL	60050	3	2,740	-	2,750	980	2,700	1,630	1,230	2,260	1,390	1,550	770

Table 11.

1984
SWPP RADIAL LAKE SURVEY SUMMARY TABLE (cont'd.)

PARAMETER		STORET NUMBER	SUR-VEYS	ANNUAL MEAN										
				1I	3I	5I	7I	1J	2J	3J	4J	5J	6J	7J
TURBIDITY	N.T.U.	00076	3	0.98	0.90	0.87	0.53	1.02	1.17	0.98	0.95	0.87	0.78	0.68
ODOR, THRESHOLD	T.O.N.	00086	3	1	1	1	1	1	1	1	1	1	1	1
CONDUCTIVITY	µmhos	00095	3	283	280	278	280	282	285	285	278	282	283	277
OXYGEN DEMAND, CHEMICAL	mg/L	00335	3	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
pH		00400	3	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
RESIDUE, TOTAL NONFILTRABLE	mg/L	00530	3	4	3	3	2	4	3	3	3	3	3	3
NITROGEN, ORGANIC	mg/L	00605	3	0.18	0.16	0.16	0.16	0.16	0.14	0.17	0.15	0.14	0.16	0.16
NITROGEN, AMMONIA	mg/L	00610	3	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
NITROGEN, NITRITE - NITRATE	mg/L	00630	3	0.26	0.26	0.26	0.27	0.16	0.26	0.16	0.23	0.25	0.23	0.26
PHOSPHATE, TOTAL	mg/L	00650	3	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.01	0.02	0.01	0.02
PHOSPHATE, DISSOLVED	mg/L	00653	3	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CHLORIDE	mg/L	00940	3	9.1	9.2	8.8	8.7	9.2	9.2	9.0	9.3	9.3	9.1	9.6
SULFATE	mg/L	00945	3	22.5	22.3	22.5	22.2	22.7	22.7	22.5	22.3	22.7	22.7	22.2
PHENOL LIKE SUBSTANCES	µg/L	32730	2	-	-	-	-	< 1	< 1	< 1	< 1	< 1	< 1	< 1
IRON	µg/L	01045	3	25	24	25	12	27	31	24	21	30	18	16
PLATE COUNT, 48 HR. - 35°C	per mL	31753	3	4	3	27	4	7	6	4	3	4	23	45
COLIFORM TOTAL	per 100mL	31503	3	2	1	0	0	1	0	0	0	0	1	2
COLIFORM, FECAL	per 100 mL geo. mean	31616	3	0	0	0	0	1	0	0	0	0	0	0
STREP, FECAL	per 100mL	31679	3	-	-	-	-	0	0	0	0	0	0	0
FUNGI	per mL	31856	3	1.7	0.7	1.7	1.0	2.4	0.7	0.7	1.3	0.7	1.3	1.3
ACTINOMYCETES	per mL	80148	3	0.1	0.6	0.2	0.4	0.2	0.3	0.2	0.5	0.2	0.4	0.3
PLANKTON	per mL	60050	3	1,660	1,480	870	580	4,220	-	2,460	-	2,690	-	1,480

Individual sample station averages for total phosphate ranged from 0.010 to 0.030 mg/L, with thirteen of the twenty-two annual averages in excess of the IPCB water quality standard for Lake Michigan of 0.021 mg/L. The all station average in 1984 was 0.024 mg/L compared to 0.011 mg/L in 1983 and 0.015 mg/L in 1982. Thirty-six percent of the samples collected during 1984 on the three SWPP Radial Lake Surveys were in violation of the water quality standard, compared to zero percent in 1983, and 17% in 1982. Differences in the number of violations of the phosphate standard over the past three years are related to sampling dates. Most of the violations in 1982 (64%) and 1984 (71%) were found in October (fall turnover). Samples were not collected in October of 1983.

Annual individual station averages for chloride ranged from 8.3 to 9.6 mg/L, with an all station average of 9.1, which is down from the 9.9 mg/L in 1983. The IPCB water quality standard for chloride is 12.0 mg/L. None of the SWPP Radial Survey samples exceeded the chloride standard.

In 1984, individual station averages for sulfate ranged from 22.0 to 22.7 mg/L, with an all station average of 22.4 mg/L, as compared to 21.6 in 1983 and 22.9 in 1982. None of the samples in 1984 were in excess of the water quality standard for sulfate of 24.0 mg/L.

PHYTOPLANKTON MONTHLY VARIATION, 1984

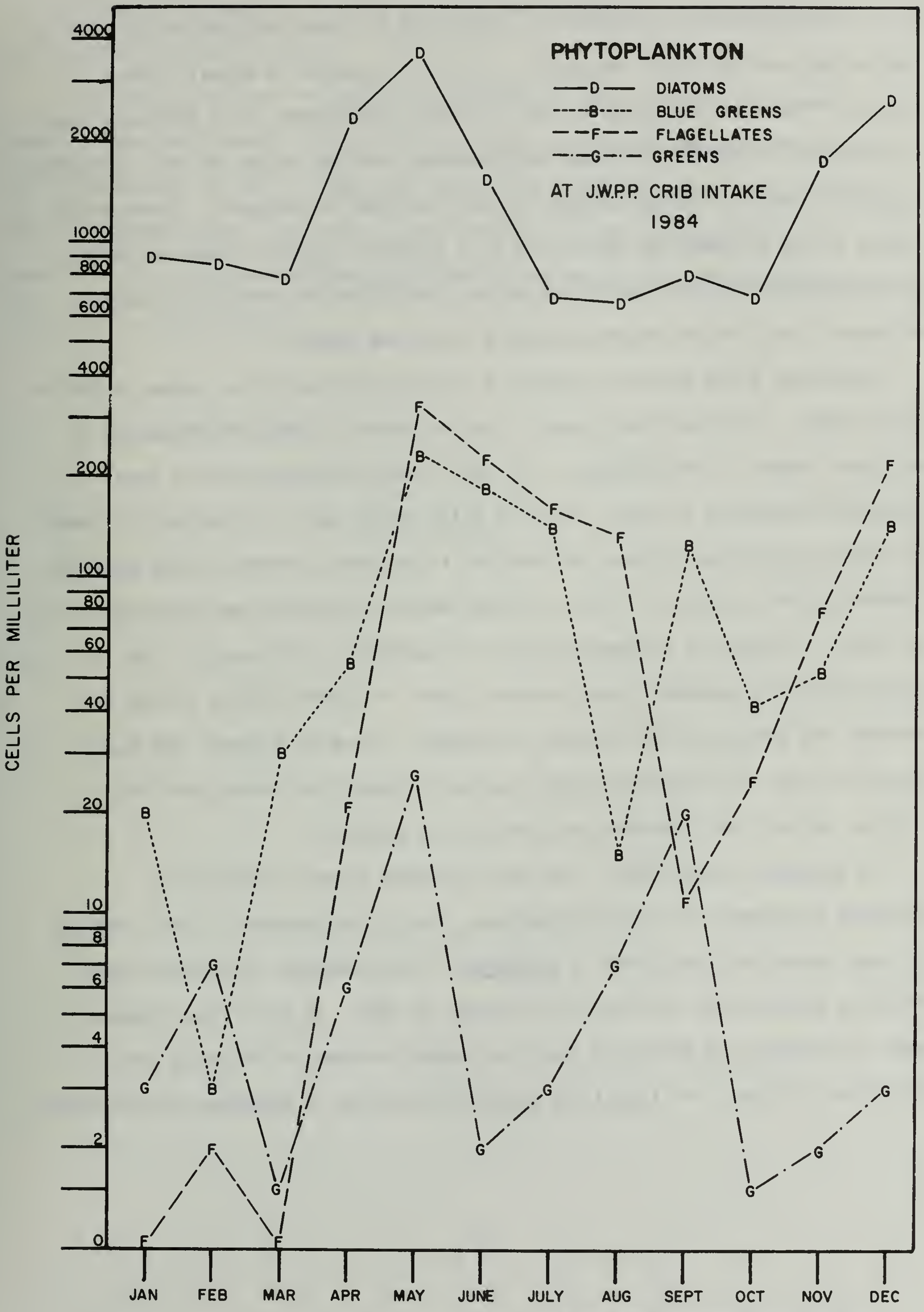
Phytoplankton were divided into four general groups for evaluation purposes: diatoms, blue-green algae, pigmented flagellates and green algae. Phytoplankton composition varies qualitatively and quantitatively from lake to lake, and seasonally within any given body of water. These variations are dependent upon a number of environmental factors including light, temperature, dissolved solids (particularly those dissolved solids or nutrients necessary for phytoplankton production), and upon biological features such as population adaptability and competition.

A monthly summary of phytoplankton data collected from the Jardine Water Purification Plant crib intake during 1984 is presented in Figure 7.

Lake Michigan lies in a temperate region of the world that produces various assemblages of phytoplankton. Diatoms are the most abundant algae of Lake Michigan (Tarapchak and Stoemer, 1976). Not only are diatoms the most abundant algae of larger lakes in temperate zones, but they are a unique algae that utilize silica, rather than cellulose, as a major component in the cell wall. Seasonal blooms or pulses in diatom populations may occur, usually as two conspicuous blooms, one in early spring and another in autumn. Three or more blooms per year are not unusual. These pulses in population are dependent upon many factors and are not completely understood. One factor that creates change in Lake Michigan is the seasonal turnover during spring and fall as defined by the nature of the thermocline (temperature barriers) at different times of the year (Whipple, et al, 1933).

Diatoms continue to dominate in numbers over the other phytoplankton groups in the southwestern portion of Lake Michigan comprising 87% of the total number. The seasonal variations in 1984 for diatoms were typical for a large temperate zone lake. These variations consisted of increasing populations in

Figure 7. Monthly summary of phytoplankton data collected at the crib intake of the Jardine Water Purification Plant



the spring, eventually peaking at a record high of 3,648 cells per milliliter in May, before descending to the annual low of 671 cells/mL in August. After a slight increase in population to 801 cells/mL in September, they decreased again to 690 cells in October. October and November mark the second or fall turnover, reaching a monthly average maximum of 2,615 cells/mL in December. These major diatom pulses followed the spring and fall seasonal turnovers when nutrients that accumulated in the hypolimnion during stratification were distributed throughout the lake and became available for algae growth.

Blue-green algae typically exhibit a spring pulse and a late summer pulse in large lakes. The blue-green algae in Lake Michigan in 1984 constituted 5% of the total number of phytoplankton. In 1984, the blue-green algae in Lake Michigan experienced an annual low of 3 cells per mL early in February followed by a sharp and steady increase through May to an annual maximum of 235 cells/mL, compared to 831 cells/mL in 1983. A sharp decline in August was observed (to 15 cells/mL), followed by an immediate peak in September of 128 cells. The populations of blue-green algae decreased again in October before rising in November and ending at 142 cells/mL in December. As with diatoms, the major population peak of blue-green algae occurred following the spring and fall turnover periods when nutrient availability is greatest.

The pigmented flagellates, like the blue-green algae, constitute an important 6% segment of the phytoplankton. One of the abundant filter clogging and odor producing flagellates is Dinobryon. The pigmented flagellates were virtually non-existant for the first quarter of 1984. In April their numbers began to increase and peaked in May to an annual maximum of 327 cells per milliliter. In June, the flagellate population started to decrease and continued to do so until September; a steady increase was observed through December, ending 1984 with 220 cells/mL.

Green algae may occur in small-scale blooms or pulses during the summer months, some simultaneously with blooms of blue-green algae and diatoms. For the southwestern portion of Lake Michigan during 1984, the green algae occurred in low concentrations (less than 8 cells per mL) for ten months out of the year. The only substantial peaks occurred during May and September with 26 and 20 cells/mL, respectively.

SECTION B

WATER QUALITY TREND ANALYSIS

1974 - 1984

In this section, current year (1984) data will be compared to data from the 10 previous years for the Open Water, North Shore and South Shore Surveys to determine long-term trends. The breakdown of data by surveys is done to better understand and identify localized water quality conditions within the southwestern basin of Lake Michigan. These particular surveys were selected in part because of the frequency at which they are performed. The North and South Shore Surveys were chosen because of their close proximity to shore discharges; the Open Water Survey because of its large coverage area away from shore influences.

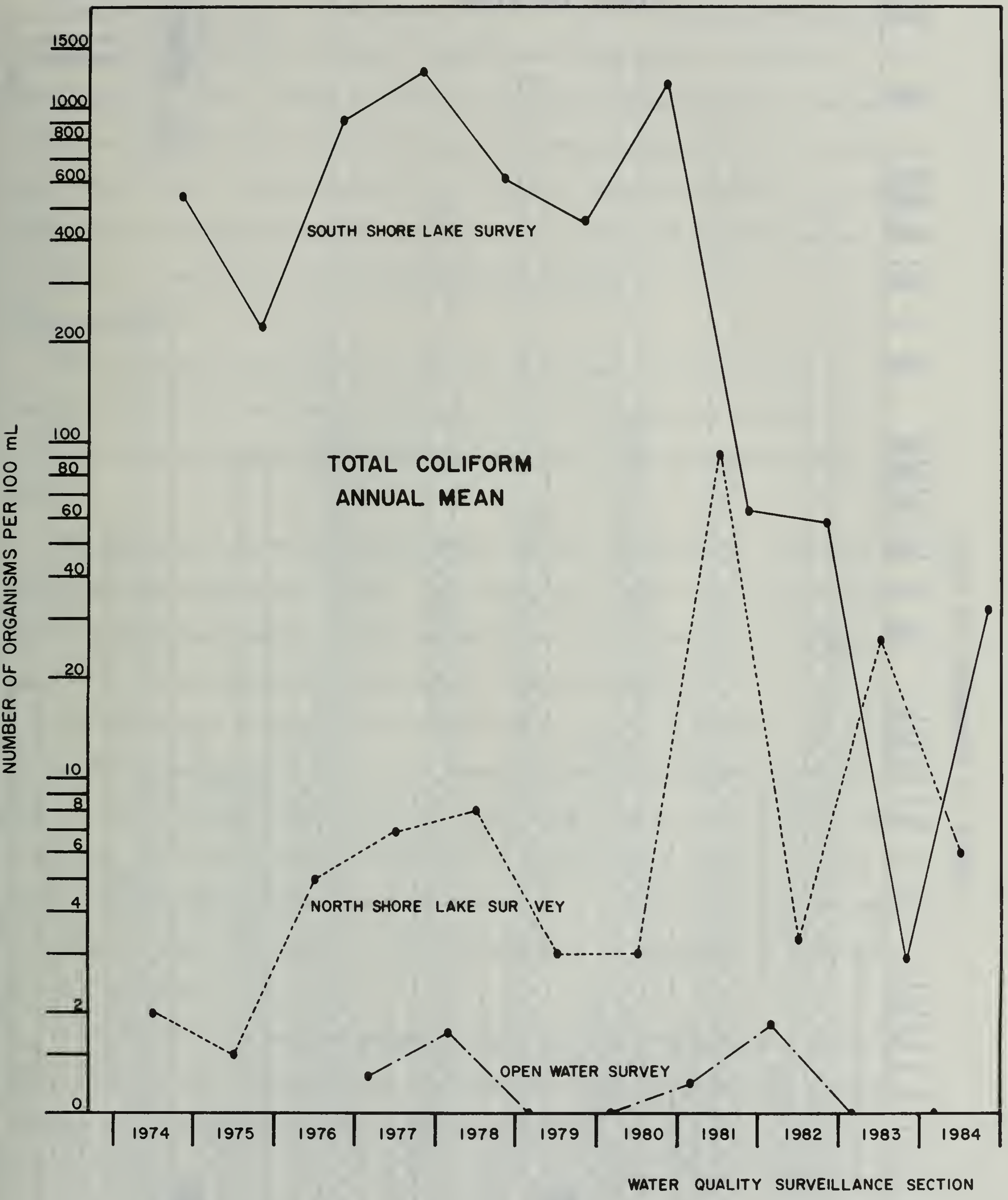
The parameters evaluated in this trend analysis are: total coliform, fecal coliform, ammonia nitrogen, total phosphate, chloride, sulfate and phytoplankton. These parameters were selected because they have designated IPCB standards assigned to them or because high concentrations are indicative of degraded or polluted water.

TOTAL COLIFORM

Total coliform counts for the Open Water Lake Survey have remained relatively stable since first sampled in 1977. The annual means for total coliform from 1977 through 1984 have ranged from zero to two organisms per 100 mL, indicating excellent water quality.

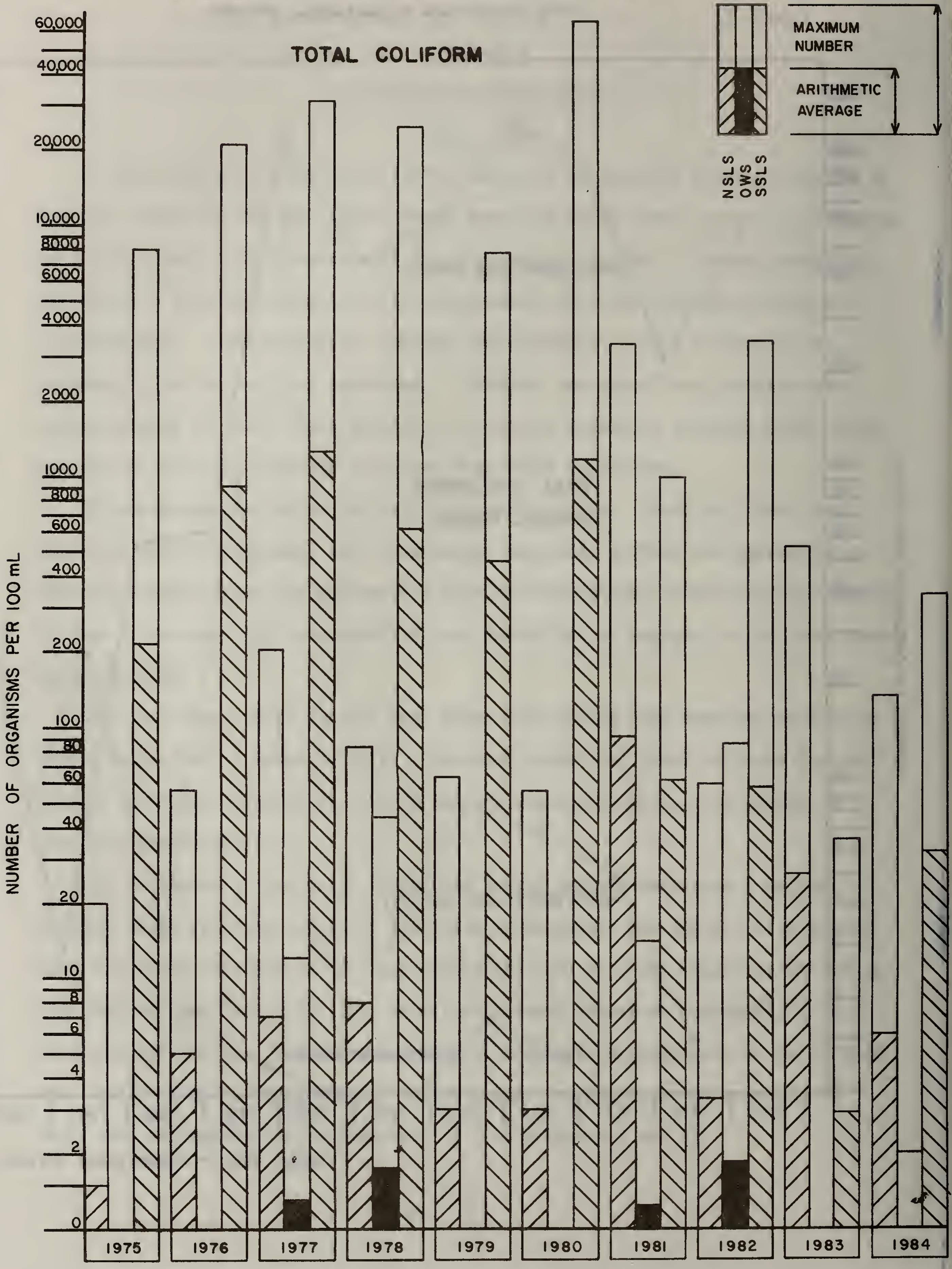
Data collected on the North Shore Lake Survey in 1984 indicated a return to lower total coliform levels of less than 10 organisms per 100 mL. The annual means for total coliform on the NSLS ranged from one to eight organisms per 100 mL from 1974 through 1980. The 1981 annual mean level increased substantially to 91 organisms per 100 mL. In 1982 the number of organisms dropped back to the 1979-80 mean levels of three organisms per 100 mL before increasing to 26 organisms in 1983, then decreasing to six organisms in 1984 (Figures 8 and 9).

Figure 8. Total coliform trends in Lake Michigan, 1974-1984



WATER QUALITY SURVEILLANCE SECTION

Figure 9. Average and maximum concentrations of total coliform, 1975-1984



The trend for total coliform annual mean levels on the South shore Lake survey appears to be downward. In Figure 8 higher annual mean values fluctuated throughout the 1970's. After a second ten year record high of 1,198 organisms in 1980, the total coliform annual mean levels decreased substantially for three years to a record low of 3 organisms per 100 mL in 1983. Although the 1984 annual mean increased to 33 organisms per 100 mL, it is still within the overall downward trend in total coliform on the entire South Shore Lake Survey.

FECAL COLIFORM

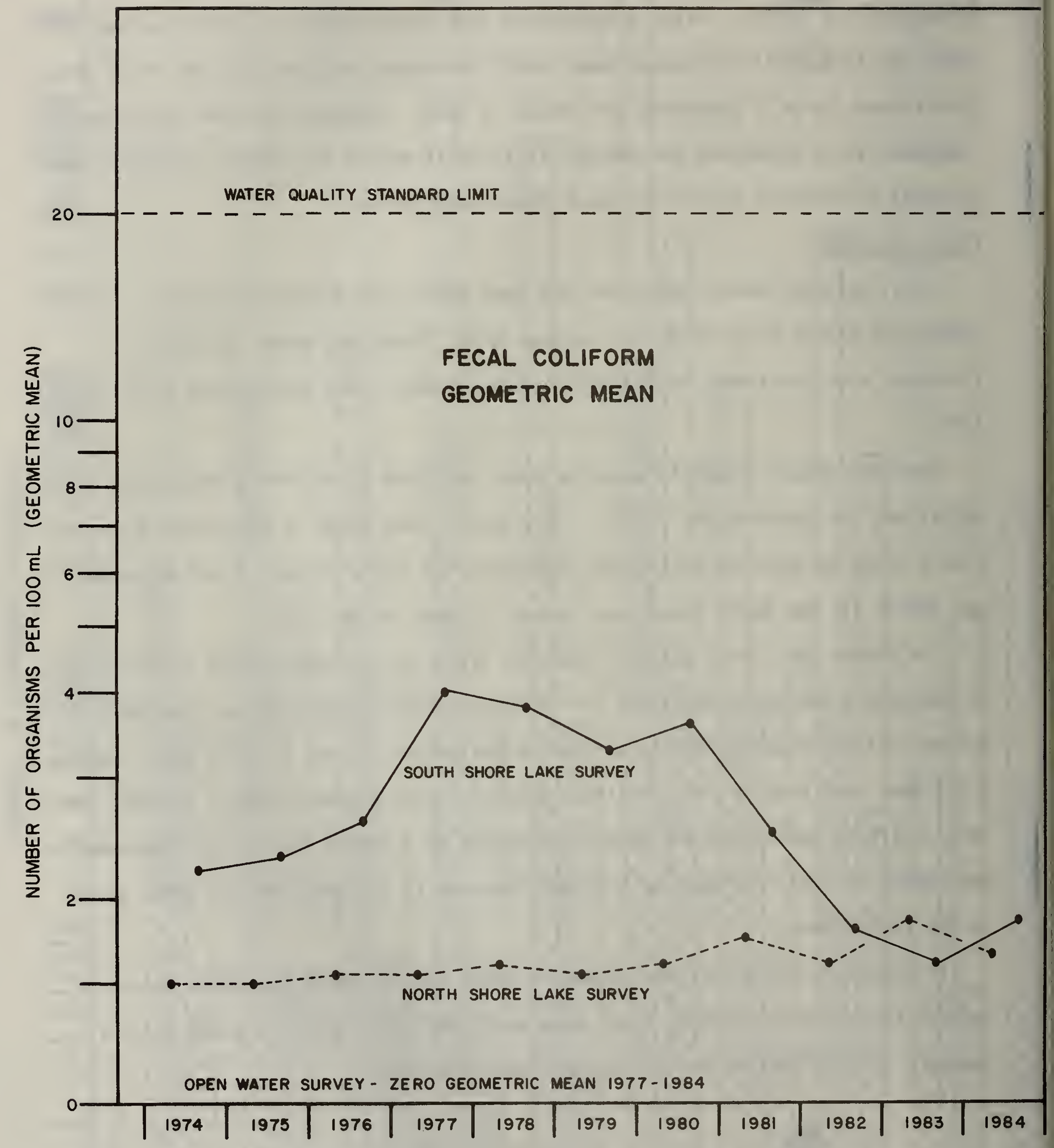
Fecal coliform annual means for the Open Water Lake Survey exhibited a continuing stable trend from 1977 through 1984. Excellent water quality is indicated with consistent annual mean values of zero since this survey began in 1977.

The 1984 annual geometric mean for fecal coliform on the North Shore Lake Survey was one organism per 100 mL. This annual mean level is consistent with the stable trend established during the preceeding ten years of one to two organisms per 100 mL for the North Shore Lake Survey (Figures 10 and 11).

The eleven year fecal coliform downward trend for the South Shore Lake Survey is depicted graphically in Figure 10. Fecal coliform concentrations from 1974 through 1977 increased steadily to four organisms per 100 mL in 1977, which denotes a thirteen year high in fecal coliform annual geometric mean levels. In 1978, the fecal coliform concentrations began to decrease to a record low of 1.2 organisms per 100 mL in 1983, followed by a slight increase to 1.7 organisms in 1984, which is not significant.

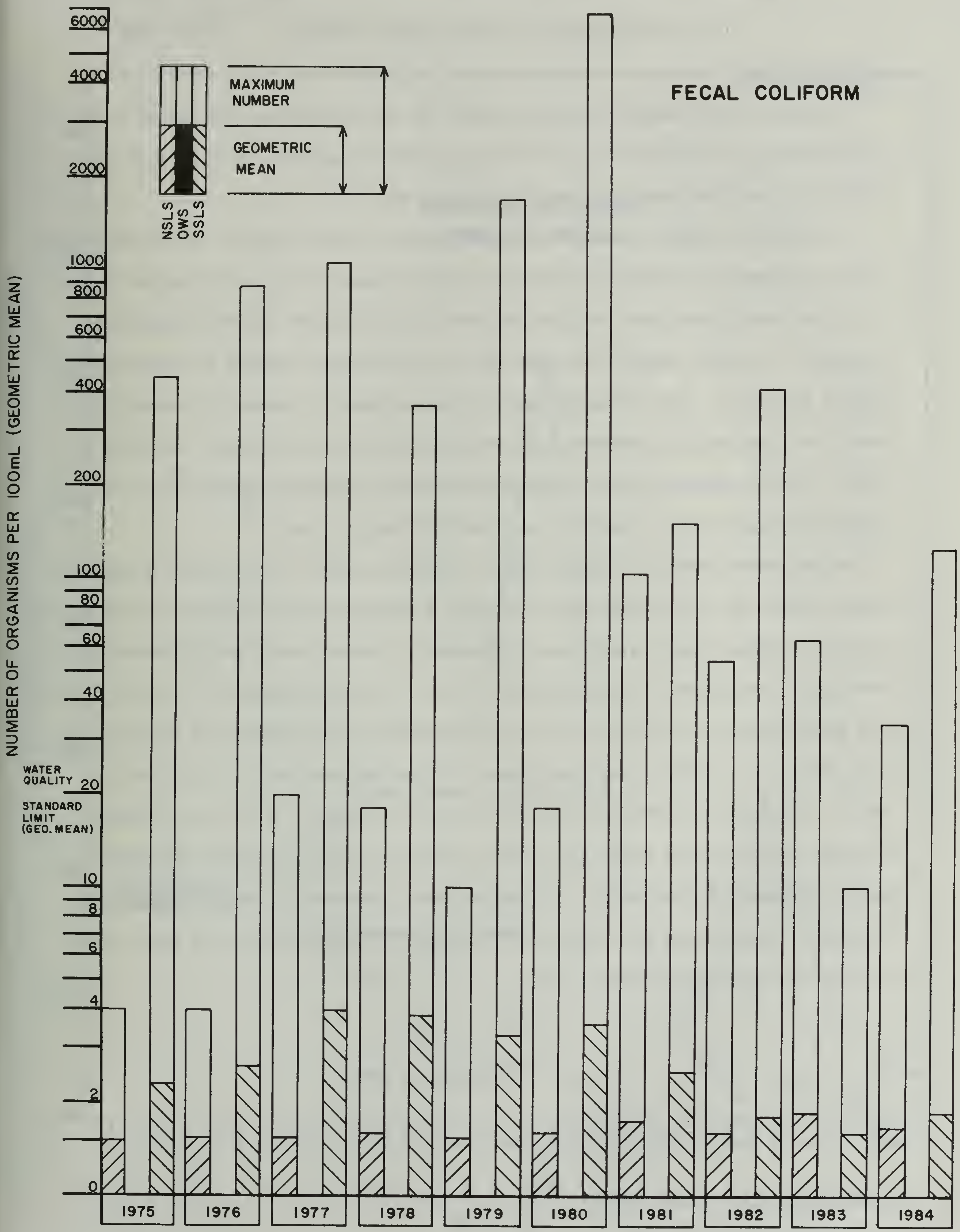
It should be noted that the geometric means for the North and South Shore Surveys for the past fourteen years have been well below the IPCB water quality standard of 20 organisms per 100 mL for fecal coliform.

Figure 10. Fecal Coliform trends in Lake Michigan, 1974-1984



WATER QUALITY SURVEILLANCE SECTION

Figure 11. Geometric mean and maximum concentrations of fecal coliforms, 1975-1984



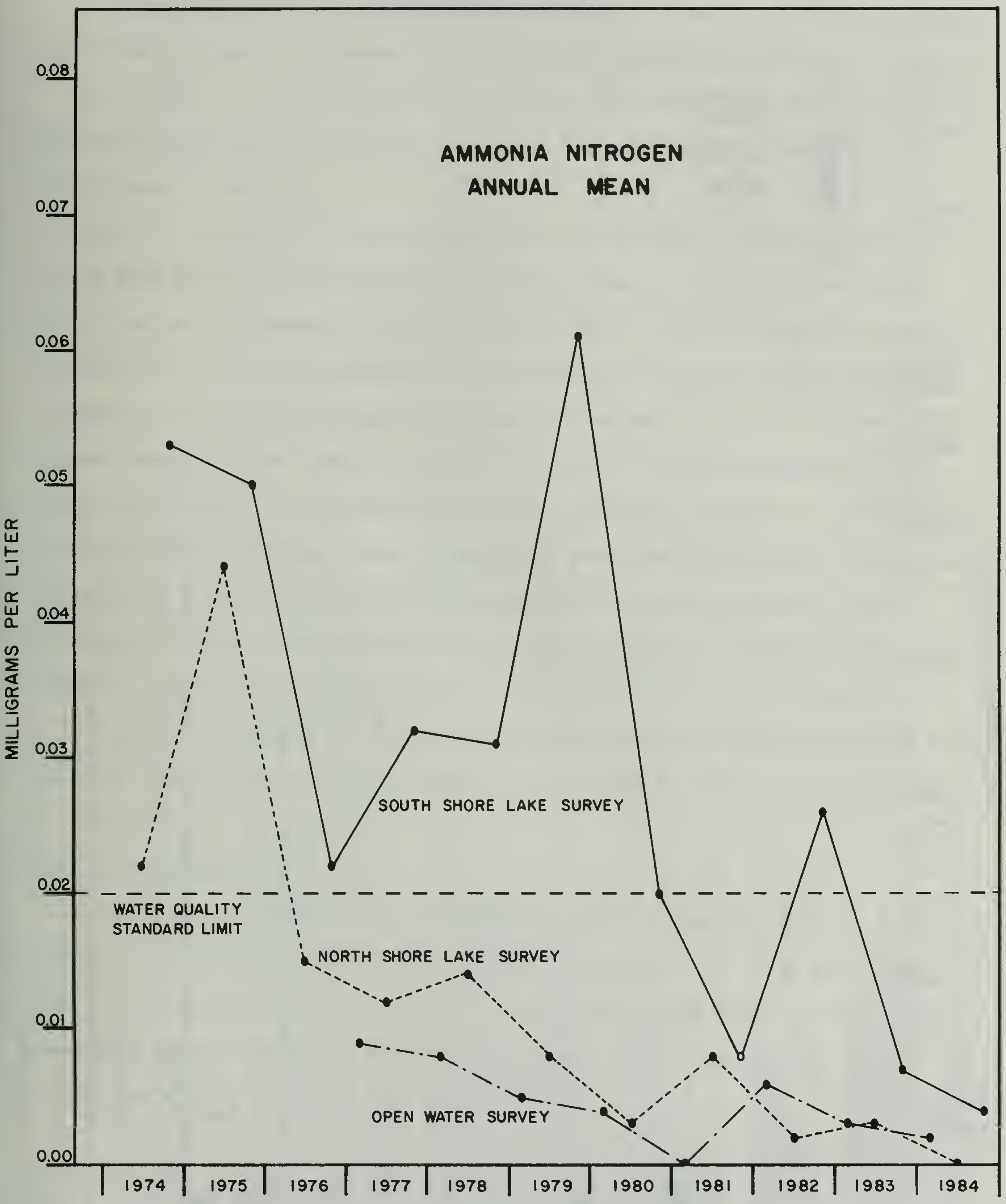
AMMONIA NITROGEN

The annual mean ammonia nitrogen values for the Open Water Lake Survey since its inception in 1977 were at or below the minimum detectable level of 0.01 mg/L, indicating excellent water quality (Figures 12 and 13).

The annual arithmetic mean levels for the past eleven years on the North Shore Lake Survey exhibit a definite downward trend in ammonia nitrogen (Figures 12 and 13). The annual mean level in 1974 was near the IPCB water quality standard of 0.02 mg/L. In 1975, ammonia nitrogen mean concentrations reached an eleven-year high of 0.04 mg/L. The following year the annual mean for ammonia nitrogen fell below the water quality standard and remained stable near 0.01 mg/L from 1976 to 1978. In 1979, the mean value dropped below the minimum detectable limit for ammonia nitrogen and has remained less than 0.01 mg/L since.

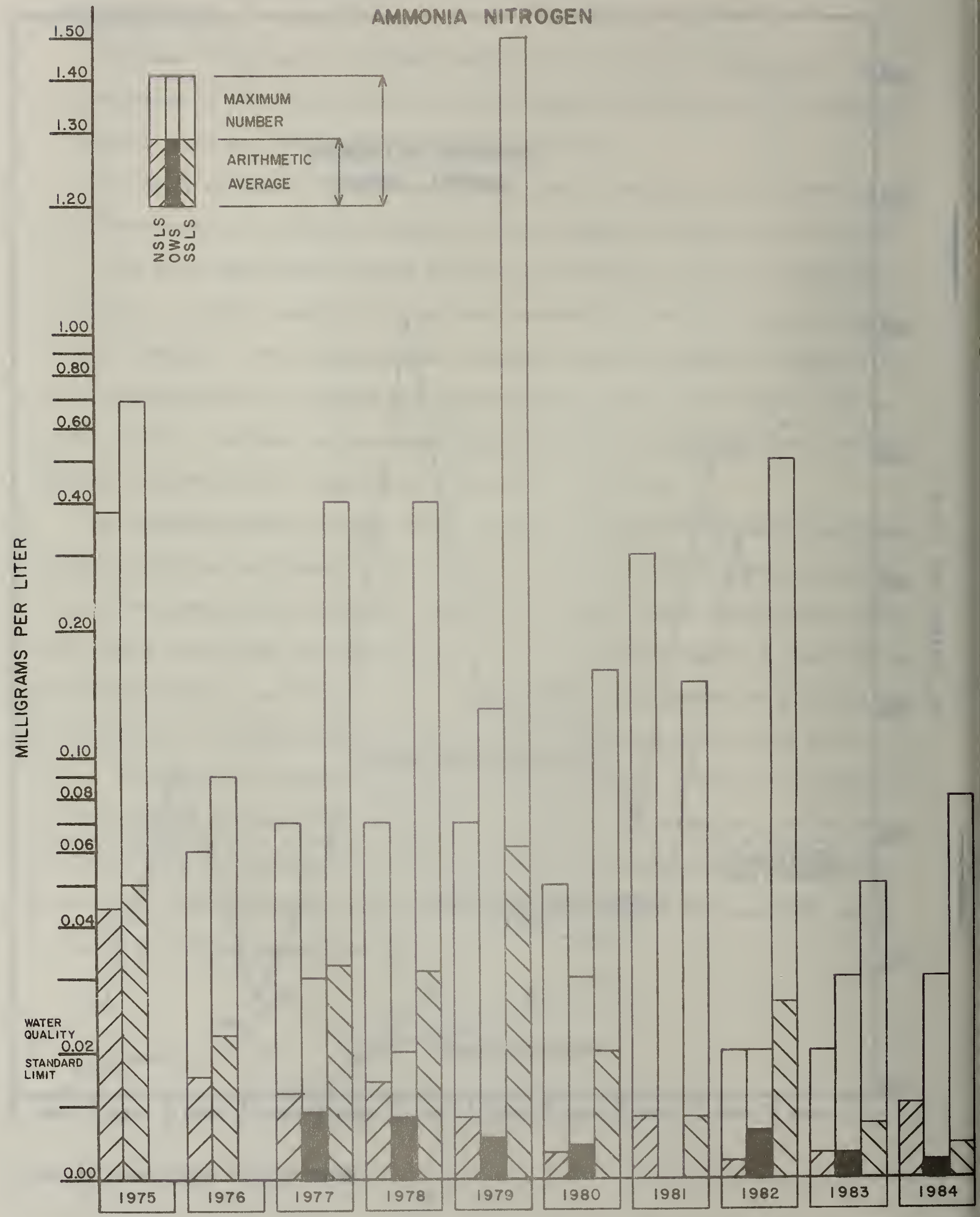
The recorded ammonia nitrogen annual arithmetic means for the South Shore Lake Survey within the last eleven years indicate a downward trend (Figures 12 and 13). Since 1974, annual mean values have fluctuated. However, each time the mean value decreased a new record low was achieved. This is depicted clearly in Figure 12 for 1976 (0.022 mg/L). In 1977 mean levels began to increase, peaking at 0.06 mg/L in 1979, which is an eleven-year high since 1974, before descending to 0.02 mg/L in 1980. It continued to drop in 1981 to less than 0.01 mg/L, a new low in ammonia nitrogen levels and the first time annual mean levels fell below the IPCB water quality standard of 0.02 mg/L. In 1982 the mean increased above the standard to 0.026 mg/L, only to decrease again to less than 0.01 mg/L in 1983 and 1984, which is below the minimum detectable limit.

Figure 12. Ammonia nitrogen trends in Lake Michigan, 1974-1984



WATER QUALITY SURVEILLANCE SECTION

Figure 13. Average and maximum concentrations of ammonia nitrogen, 1975-1984



TOTAL PHOSPHATE

An eleven year analysis, as illustrated in Figures 14 and 15, indicates a fluctuating but generally downward trend of total phosphate concentrations.

Annual mean levels for total phosphate on the Open Water Lake Survey since 1977 have decreased overall and have remained below the water quality standard since 1981 (Figures 14 and 15).

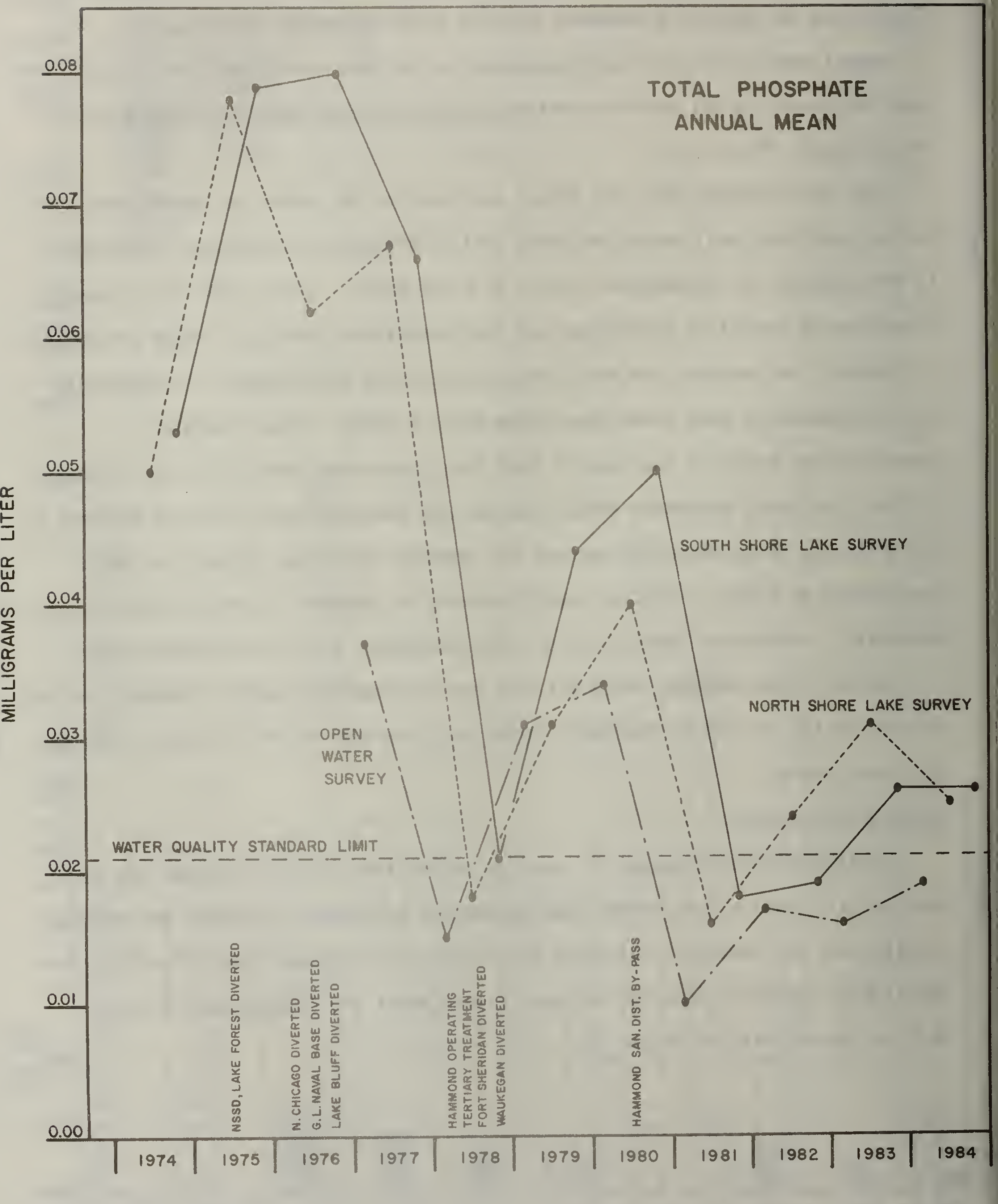
From 1974 through 1977, the annual averages for the North and South Shore Lake Surveys were both well above the water quality standard of 0.021 mg/L (equivalent to the standard for phosphorous, as P. of 0.007 mg/L). Since 1978, after several diversions of municipal discharges and the operation of tertiary sewage treatment in Hammond, the averages for both surveys were below the standard at least twice and were generally much lower than those prior to 1978. Total phosphate concentrations began to increase in 1982 from levels that were below the standard. In 1983, the total phosphate annual average was above the water quality standard on the North and South Shore Surveys and has remained above the standard in 1984. Care should be taken in placing significance on an apparent increase in total phosphate. Laboratory capability for total phosphate is to the hundreths place.

Samples which exceeded the 0.021 mg/L total phosphate standard dropped from 80% in 1972 to 43% in 1984 on the North Shore, and from 82% in 1972 to 55% in 1984 on the South Shore.

CHLORIDE AND SULFATE

Annual mean concentrations of chloride and sulfate in Lake Michigan are based upon the all station data rather than separately by survey. Chloride and sulfate samples were not routinely collected on all five lake surveys from 1974-1977. The annual mean concentrations for the past eleven years are illustrated for both chloride and sulfate in Figure 16.

Figure 14. Total phosphate trends in Lake Michigan, 1974-1984



WATER QUALITY SURVEILLANCE SECTION

Figure 15. Average and maximum concentrations of total phosphate, 1975-1984

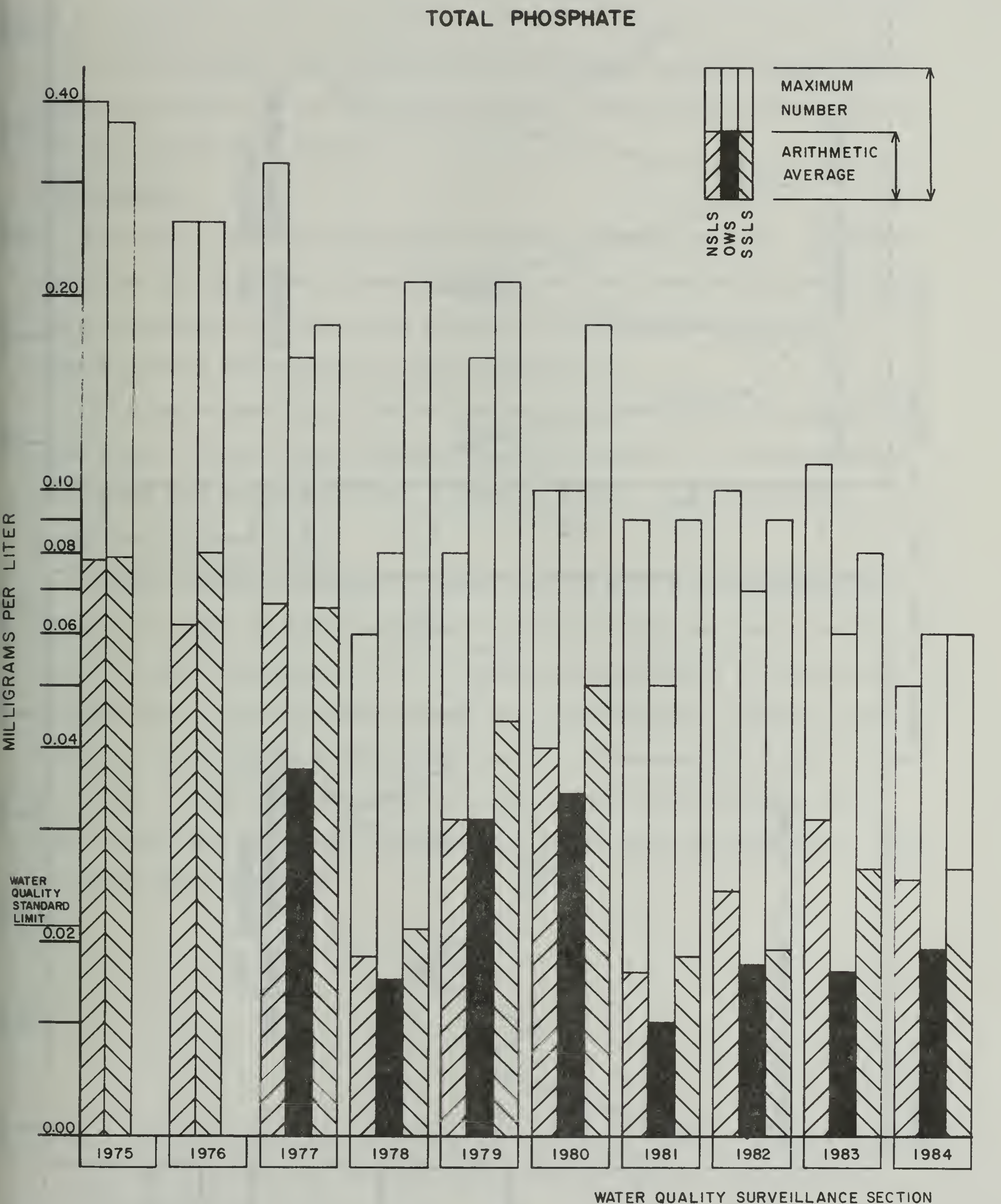
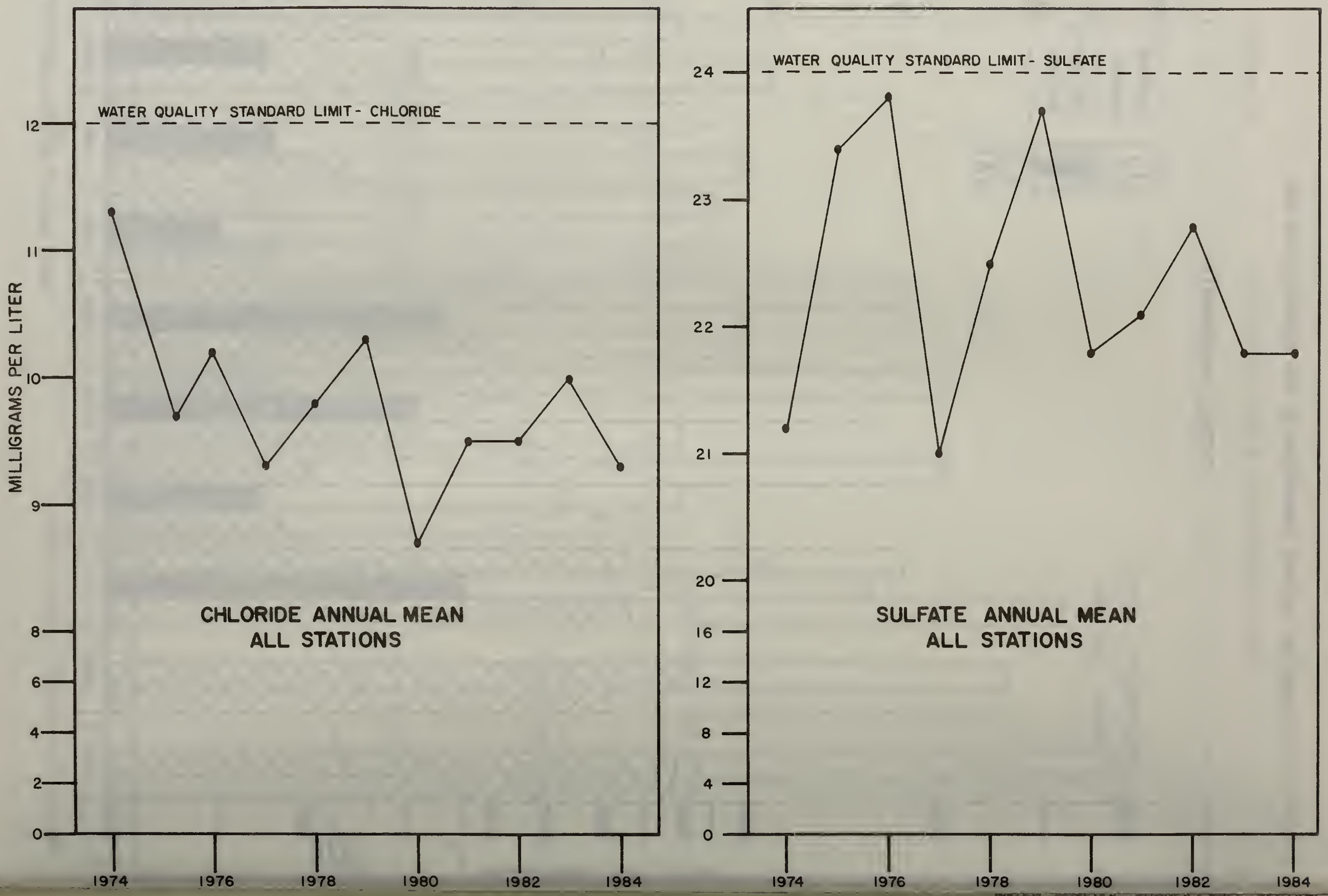


Figure 16. Chloride and Sulfate trends in Lake Michigan, 1974-1984



Mean chloride levels have fluctuated during the past eleven years, ranging from 8.7 to 11.3 mg/L, and have been below the Illinois Pollution Control Board standard of 12.0 mg/L.

Fluctuating annual mean sulfate levels were recorded from 1974 through 1984. The highest annual mean for past years occurred in 1976 (23.8) mg/L and was below the IPCB standard of 24.0 mg/L.

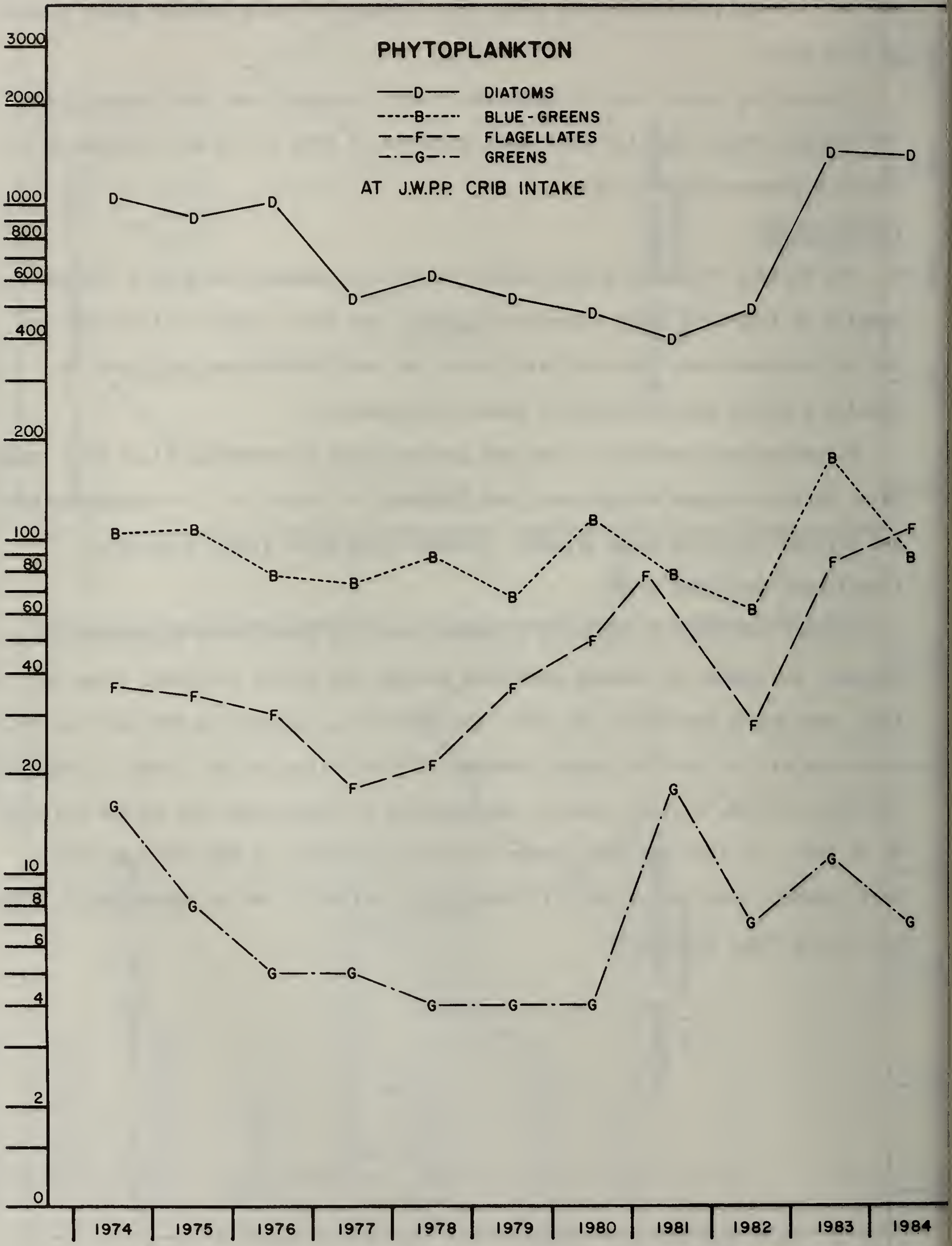
PHYTOPLANKTON

The factors affecting phytoplankton variations, whether short term (seasonal or annual) or long term (over a number of years), and their inter-relationships are not fully understood. Further data collection and research are necessary to develop a better understanding of these relationships.

Phytoplankton sample data from the Jardine Water Purification Plant Crib Intake water during the past eleven years are presented in Figure 17. The phytoplankton are divided into four major groups: diatoms, blue-green algae, pigmented flagellates and green algae.

Diatoms continued to dominate in number over the other three phytoplankton groups. The number of diatoms decreased through the 1970's and after a low in 1981, they again increased. In 1977, the annual mean dropped to 520 cells per mL, less than half of the 1974 annual average of 1,074 cells per mL. After a slight increase in 1978, diatoms steadily decreased to an eleven-year low of 400 cells per mL in 1981. In 1983 and 1984, after increasing slightly to 485 cells in 1982, their numbers grew dramatically to 1,484 and 1,443 cells per mL respectively, which are record highs since 1972.

Figure 17. Phytoplankton trends in Lake Michigan, 1974-1984



WATER QUALITY SURVEILLANCE SECTION

Blue-green algae for most of the past eleven years have generally exhibited only slight yearly variations indicating an apparently stable trend. However, in 1983 the blue-green algae exhibited an eleven year high of 178 cells per mL, but decreased in 1984 to 88 cells per mL, more in line with the eleven year mean of 94 cells per mL.

An eleven year analysis of the pigmented flagellates, as illustrated in Figure 17, indicates an apparent upward trend. A steady increase in numbers from 1977 through 1981 and a sharp rise in 1983 resulted in an eleven year high of 85 cells per mL, which was surpassed in 1984 to a new record high of 103 cells. This is the first year in the last thirteen in which the pigmented flagellates have out-numbered the blue-green algae. Previously the pigmented flagellates annual averages equalled approximately one half of the blue-greens. The eleven year annual mean from 1974 through 1984 was 47 cells per mL.

During the last eleven years, the green algae appeared stable with annual averages ranging from 4 to 18 cells per mL. The green algae steadily decreased from 16 cells/mL in 1974 to an eleven year low of 4 cells in 1978. It remained at 4 cells until 1981 when a record high of 18 cells/mL was achieved. The green algae appeared to have stabilized at 7 cells/mL in 1982, near the eleven-year mean of 8 cells. After a slight increase to 11 cells per mL in 1983, the green algae annual mean returned to 7 cells/mL in 1984.

SECTION C

TROPHIC STATE EVALUATION

A wide range of physical, chemical, and biological parameters have been used to describe freshwater lakes, and the multitude of descriptive indices and lake classification systems that have evolved have been summarized by Uttormark and Wall (1975), Sefton (1978), and Van Benschoten (1978). Lakes have been historically classified by their geologic origin and more recently on the basis of productivity or trophic status. Traditionally, lakes classified by trophic status have been placed into three broad categories (Sefton 1978):

1. Oligotrophic lakes have low concentrations of nutrients such as phosphorus and nitrogen and support little plant growth. Biological productivity is generally low, and the waters are clear (Naumann 1919, 1931; Hasler 1947; Hasler and Ingersoll 1968; Vollenweider 1968).
2. Mesotrophic lakes are intermediate in character between oligotrophic and eutrophic. They are moderately well supplied with nutrients and generally support moderate biolocical productivity.
3. Eutrophic lakes are nutrient rich and generally highly productive, capable of supporting a large amount of plant growth and other biological activity (Naumann 1919; Hasler 1947; Hasler and Ingersoll 1968; Vollenweider 1968). Eutrophic lakes cover a myriad of water quality conditions, ranging from very desirable recreational lakes that support excellent warmwater fisheries, to lakes with undesirable aesthetics and water use limitations (Rogers 1977).

The eutrophication process is classically defined in terms of natural glacial lakes. Glaciated lakes normally begin as oligotrophic bodies of water with stable water quality and long natural successional lives. Increases in productivity of their waters are generally brought about by increasing nutrient concentrations.

TROPHIC STATE INDEX

For comparison purposes, trophic state index values were computed using equations developed by Carlson (1977). Carlson constructed his Trophic State Index (TSI) such that the zero point on the scale would denote a Secchi transparency depth (SD) greater than any yet encountered; the greatest known SD is 41.6 meters for a lake in Japan. The formula was thus developed so that TSI(SD) value of zero is obtained for a Secchi reading of 64 m; a value of 10 is obtained when SD=32 m, 20 for 16 m, 30 for 8 m and so forth. The theoretical limit is infinity; however, the practical limit of 100-110 is reached when transparency is from 0.064 - 0.032 m. Carlson also developed TSI formulae using total phosphorus (TP in ug/L) and chlorophyll a (CHLa in ug/L) data based on empirical relationships of these two parameters with SD, as follows:

$$\mathrm{TSI(SD)} = 60 - 14.41 \ln \mathrm{SD}$$

$$\mathrm{TSI\ (CHL\underline{a})} = 9.81 \ln \mathrm{CHL\underline{a}} + 30.6$$

$$\mathrm{TSI(TP)} = 14.41 \ln \mathrm{TP} + 4.15$$

The higher the TSI value, the more eutrophic the lake. Each major division of the index (10, 20, 30, etc.) represents a doubling of algal biomass. Lakes with TSI values less than 40 are classified as oligotrophic (relatively unproductive), those with TSI values between 40 and 50 are considered mesotrophic (moderately productive), and those with TSI values greater than 50 are classified as eutrophic (highly productive)(Allum, et. al. 1977; Carlson 1977).

Total Phosphorus (equivalent to total phosphate ÷ 3.067) is the only one of these parameters which is routinely monitored in Lake Michigan. The all station TSI(TP) in 1984 was 31.1. Individual station TSI(TP) ranged from 21.4 at stations 10, 13, 10N, 4J and 6J to 44.4 at stations 1A, 4A and 1D. North Shore and South Shore TSI(TP) values were 31.1 and 37.1 respectively. The TSI(TP) for nearshore stations (<3 miles from shore) was 37.1 compared to 31.1 for offshore stations (>3 miles from shore).

North Shore and South Shore TSI(TP) values from 1970 to 1984 are compared in Table 12. The TSI(TP) values have decreased significantly since 1977. From 1970 to 1977 the TSI(TP) values ranged from 41.1 to 54.0 with a mean (± SD) of 47.7 (± 3.6). Since 1978, the TSI(TP) values have ranged from 31.1 to 44.4 with a mean of 35.2 (± 4.7). This represents a calculated reduction in algal biomass of 56%. The greatest change in the trophic state of the lake occured between 1977 and 1978. The TSI(TP) decreased from 49.2 in 1977 to 31.1 in 1978, resulting in a calculated reduction in algal biomass of 70%.

Total phosphorus and chlorophyll samples were collected at JWPP stations 5A, 5B, 1C, 5C, 5D and 4E on May 30 and July 31 and at SWPP stations 3F, 5G, 5H, 5I, 2J and 5J on May 16 and October 2, 1984. Chlorophyll a concentrations are summarized in Table 13. TSI (Chl a) values ranged from 0.0 to 49.8 with a mean of 31.8 (± 16.8), compared to TSI(TP) values ranging from <21.4 to 51.2 with a mean of <33.8 (± 8.8) (Tables 14 and 15). According to Steinhart et. al. (1981), the estimated background levels of chlorophyll a and total phosphorus in Lake Michigan are 1.8 ug/L and 7.0 ug/L (0.02 mg/L total phosphate) respectively. These concentrations correspond to a TSI (Chl a) of 36.4 and a TSI(TP) of 32.2.

Table 12. Trophic State Index (Total Phosphorus[1,2]) for the southwestern portion of Lake Michigan 1970-1984.

Year	North Shore	South Shore	Open Water	Nearshore[3]	Off Shore[4]	All Station
1970	47.0	49.2	-	-	-	-
1971	47.0	41.1	-	-	-	-
1972	49.2	47.0	-	-	-	-
1973	41.1	54.4	-	-	-	-
1974	44.4	44.4	-	-	-	-
1975	51.2	51.2	-	-	-	-
1976	47.0	51.2	-	-	-	-
1977	49.2	49.2	41.1	-	-	-
1978	31.1	31.1	31.1	31.1	31.1	31.1
1979	37.1	41.1	37.1	41.1	41.1	41.1
1980	41.1	44.4	37.1	44.4	41.1	41.1
1981	31.1	31.1	21.4	31.1	31.1	31.1
1982	31.1	31.1	31.1	31.1	31.1	31.1
1983	37.1	37.1	31.1	37.1	31.1	31.1
1984	31.1	37.1	31.1	37.1	31.1	31.1

1) Total Phosphorus ug/L x 3.067 = Total Phosphate ug/L
2) Annual mean total phosphate concentrations, rounded to the hundreth place (significant figure) and converted to total phosphorus, were used to calculate the TSI values.
3) Less than 3 miles from shore: includes some North Shore, South Shore, JWPP and SWPP stations.
4) Greater than 3 miles from shore: includes some North Shore, South Shore, JWPP, SWPP and all Open Water stations.

Table 13. Summary of chlorophyll a concentrations (ug/L) at 12 Lake Michigan stations, 1984.

	JWPP	SWPP	Total
Number	12	11	23
Minimum	0.38	0.00	0.00
Maximum	7.10	4.78	7.10
Mean	2.71	2.27	2.50
SD	2.29	2.09	2.16

JWPP - Stations: 5A, 5B, 1C, 5C, 5D & 4E (5/30/84 and 7/31/84)
SWPP - Stations: 3F, 5G, 5H, 5I, 2J & 5J (5/16/84 and 10/2/84)
SD - Standard Deviation

Table 14. Summary of Trophic State Index (TSI) values for total phosphorus and chlorophyll a at 12 Lake Michigan stations, 1984.

	JWPP		SWPP		Total	
	TSI(TP)	TSI(Chla)	TSI(TP)	TSI(Chla)	TSI(TP)	TSI(Chla)
Number	12	12	12	11	24	23
Minimum	31.1	21.1	<21.4	0.0	<21.4	0.0
Maximum	44.4	49.8	51.2	45.9	51.2	49.8
Mean	36.0	36.4	<31.7	26.8	<33.8	31.8
SD	5.6	9.7	11.0	21.6	8.8	16.8

JWPP - Stations: 5A, 5B, 1C, 5C, 5D, 4E (5/30/84 and 7/31/84)
SWPP - Stations: 3F, 5G, 5H, 5I, 2J & 5J (5/16/84 and 10/2/84)
SD - Standard Deviation

Table 15. Concentrations of Chlorophyll *a* and Total Phosphorus along with their Trophic State Index values at 12 Lake Michigan Stations, 1984.

Station	Date	Total Phosphorus		Chlorophyll *a*		Mean TSI(SD)
		ug/L	TSI	ug/L	TSI	
5A	5/30	6.5	31.1	7.10	49.8	40.4(13.2)
	7/31	13.0	41.1	1.38	33.8	37.4(5.2)
5B	5/30	9.8	37.1	4.88	46.2	41.6(6.4)
	7/31	16.3	44.4	0.86	29.1	36.8(10.8)
1C	5/30	6.5	31.1	4.15	44.6	37.8(9.5)
	7/31	9.8	37.1	1.07	29.9	33.5(5.1)
5C	5/30	6.5	31.1	4.44	45.2	38.2(10.0)
	7/31	13.0	41.1	1.34	33.5	37.3(5.4)
5D	5/30	6.5	31.1	5.23	46.8	39.0(11.1)
	7/31	6.5	31.1	0.56	24.9	28.0(4.4)
4E	5/30	6.5	31.1	0.38	21.1	26.1(7.1)
	7/31	16.3	44.4	1.11	31.6	38.0(9.0)
3F	5/16	3.3	21.4	4.72	45.8	33.6(17.2)
	10/2	26.1	51.2	-	-	-
5G	5/16	3.3	21.4	2.58	39.9	30.6(13.1)
	10/2	16.3	44.4	1.10	31.5	38.0(9.1)
5H	5/16	<3.3	<21.4	3.03	41.5	<31.4(14.2)
	10/2	19.6	47.0	0.00	0.0	23.5(33.2)
5I	5/16	<3.3	<21.4	4.39	45.1	<33.2(16.8)
	10/2	6.5	31.1	0.00	0.0	15.6(22.0)
2J	5/16	<3.3	<21.4	4.78	45.9	<33.6(17.3)
	10/2	9.8	37.1	0.00	0.0	18.6(26.2)
5J	5/16	6.5	31.1	4.37	45.1	38.1(9.9)
	10/2	6.5	31.1	0.00	0.0	15.6(22.0)
Mean(SD)		9.4(5.9)	33.8(8.8)	2.50(2.16)	31.8(16.8)	32.4(7.7)

(SD) - Standard Deviation
1 - Phosphorus ug/L x 3.067 = Phosphate ug/L.

SECTION D

STATUS OF DISCHARGERS AND BEACH QUALITY

Abbott Laboratories and Commonwealth Edison Company's Waukegan and Zion stations continue to discharge cooling water into Lake Michigan. Treatment facilities at the Waukegan station for non-thermal discharges (including ash and coal pile handling systems) are now under Agency permit. The North Shore Sanitary District's (NSSD) North Chicago and Waukegan treatment plants continue to discharge excess wet weather flows into Lake Michigan after settling and disinfection. Alternative methods of handling the wet weather flow are being studied through the Federal Construction Grant Program. The Highwood water filtration plant continues to discharge backwash water directly to Lake Michigan.

Johnson Outboards, Division of Outboard Marine Corporation

(Manufacturer of outboard motors)

The facility manufactures and assembles outboard motors in plant Nos. 1 and 2. Plant No. 3 which once served as an export shipping and service school is no longer being operated by OMC. Plant No. 1 was placed in operation in 1926 and is the site where outboard motors are assembled, painted, tested and shipped. At this plant there are located one (1) harbor intake and five (5) NPDES permitted outfalls (007, 008, 014, 015, 016). From these outfalls are discharged non-contact cooling water, stormwater runoff and roof drainage. Discharges from plant No. 1 enter Lake Michigan via Waukegan Harbor. Discharges from plant No. 2 enter Lake Michigan via North Ditch located north of the facility, except for outfalls 007 and 008, which discharges directly to Lake Michigan.

Process wastewater from electroplating, heat treating, chromate conversion coating are pretreated prior to being discharged to the North Shore Sanitary District for further treatment.

During 1975 and 1976, polychlorinated biphenyls (PCB's) were found in several discharges. The PCB's had been previously used as a hydraulic fluid in die cast machines. The U.S. Environmental Protection Agency has formulated several plans for cleanup of PCB contamination at the OMC Hazardous Waste Site in Waukegan Harbor. Further actions have been forestalled by a 1985 court decision.

MSDGC Overflows

Wastewater from all of the Lake Shore municipalities in Cook County is treated by wastewater treatment facilities of the Metropolitan Sanitary District of Greater Chicago (MSDGC). The treated effluents are discharged to a system of waterways that are tributary to the DesPlaines River. Historically, the Chicago River and the Calumet River were tributaries of Lake Michigan. However, after repeated waterborne disease epidemics in the late 1800's from contamination of the City of Chicago's drinking water by the flow of polluted river water into the lake, MSDGC constructed a canal system which reversed the direction of flow, diverting flows from Lake Michigan to the Mississippi River via the DesPlaines and Illinois Rivers. Dilution of these waste flows is provided by diversion of water from Lake Michigan at the Wilmette, Chicago River, and O'Brien locks.

Water levels in the waterways are regulated by the District's lock and dam facility at Lockport, Illinois. Whenever heavy rains are predicted, the Lockport dam is opened, lowering the water levels to prevent flood damage. However, during severe rains, the capacity of the waterways to drain away runoff may be exceeded and one or more of the locks may be opened causing polluted flood waters to reach the lake (Table 16).

The Tunnel and Reservoir Plan (TARP) adopted by the MSDGC consists of conveyance tunnels (Phase I) and storage reservoirs (Phase II) to transport and store

Table 16. Dates, locations, and volumes released during flow reversals to Lake Michigan at the Wilmette and Chicago River Locks.

Date	Location	(Millions of Cubic Feet)
1984 - None		
August 17, 1983	Wilmette	15.0
October 22, 1983	Wilmette	1.4
July 22, 1982	Wilmette	0.34
August 7, 1982	Chicago River	11.1
December 3, 1982	Chicago River	33.1
December 3, 1982	Wilmette	19.1
April 28, 1981	Wilmette	3.28
May 29, 1981	Wilmette	1.4
July 12, 1981	Wilmette	27.0
August 14, 1981	Wilmette	13.1
July 21, 1980	Chicago River	24.6
July 21, 1980	Wilmette	21.1
April 11-12, 1979	Wilmette	1.5
March 4, 1979	Wilmette	6.0
September 17, 1978	Wilmette	13.2
September 13, 1978	Wilmette	4.4
June 30, 1977	Chicago River	39.7
June 30, 1977	Wilmette	3.9
June 11, 1977	Wilmette	5.4
April 24, 1976	Wilmette	18.0
August 21, 1975	Wilmette	17.4
April 18, 1975	Chicago River	151.0
April 18, 1975	Wilmette	12.0
September 17, 1972	Wilmette	12.0
August 25, 1972	Chicago River	7.9
August 25, 1972	Wilmette	25.5
June 14, 1972	Wilmette	2.7

combined sewage overflows during periods of heavy rainfall. Subsequently, these overflows, which are presently discharged to the waterways, would be pumped to MSDGC facilities for treatment. Mainstem and Calumet segments of TARP were completed in 1984 and are being readied to be placed into operation in 1985. Reversals to Lake Michigan and resulting beach closings will essentially be elmininated (90%) when Phase I implementation is completed.

Beach Quality

There are 58 Lake Michigan bathing beaches in Illinois, 12 in Lake County and 46 in Cook County. Agencies monitoring the water quality of the beaches are: Lake County Health Department and North Shore Sanitary District (12 Lake County beaches), Evanston-North Shore Health Department (8 Cook County beaches), Village of Winnetka (4 Cook County beaches), Village of Wilmette (1 Cook County beach) and the Chicago Park District (33 Cook County beaches).

The Illinois Lake Michigan fecal coliform standard is a geometric mean of 20/100 mL (IPCB, 1982). This standard was set for the protection of Lake Michigan, whereas a 500/100 mL fecal coliform count is used for health considerations. Health departments close beaches in their jurisdiction when two consecutive samples exceed 500/100 mL fecal coliform, or when the Wilmette and Chicago River locks are opened.

A total of 4,334 fecal coliform samples were collected from June 17 to September 1, 1984. Fecal coliform counts ranged from < 1/100 mL to 8,000/100 mL. Forty-two percent of the samples were greater than 20/100 mL and 2.0% were greater than 500/100 mL (Table 17). North Ave. beach had the highest number of samples exceeding 20/100 mL (67.1%), while 49th St. beach had the lowest (13.2%). The greatest percentage of samples exceeding 500/100 mL was at Highland Park beach with 10.7%, followed by Waukegan North with 8.0%, Il. Beach State Park and Rosewood with 6.6% each and Webster with 5.3%. Sixteen of the 58 beaches did not exceed 500/100 mL fecal coliform in any of their samples.

Table 17. Summary of fecal coliform counts (No./100 mL) at 58 Illinois Lake Michigan beaches, June 17 to September 1, 1984.

Testing Agency	Beaches	Number of Samples	Min.	Max	Percent >500/100 mL	Consecutive[6] Samples >500	Percent >20	Geometric[7,8] Mean
1	Winthrop Harbor	76	2	560	2.6	0	44.7	23
1	Zion	76	<5	610	3.9	0	44.7	27
1	Il.Beach St. Park	76	<2	>960	6.6	0	42.1	28
1	Waukegan North	75	<5	>5500	8.0	1	54.7	44
1	Waukegan Central	76	2	>1900	3.9	0	42.1	24
1	Foss Park	73	<2	>720	1.4	0	32.9	17
1	Lake Bluff	76	<2	640	1.3	0	42.1	20
1	Lake Forest	76	<2	>1400	1.3	0	35.5	18
1	Highwood	74	<2	>800	2.7	0	39.2	22
1	Highland Park	75	<2	>1600	10.7	2	49.3	34
1	Ravine Dr.	75	<2	>1110	4.0	1	44.0	28
1	Rosewood	76	<2	>2500	6.6	1	50.0	30
2	Glencoe	74	<1	980	1.4	0	63.5	35
3	Tower	70	1	540	1.4	0	42.8	26
3	Lloyd	70	<4	390	0.0	0	41.4	26
3	Maple	70	<4	700	1.4	0	32.8	23
3	Elder	70	3	740	2.8	0	44.3	27
2	Kenilworth	74	<1	606	2.7	0	59.5	27
4	Wilmette(Gilson)	69	<1	182	0.0	0	42.0	11
2	Lighthouse	71	<1	610	1.4	0	59.2	25
2	Northwestern Univ.	67	<1	572	1.5	0	58.2	26
2	Clark	72	<1	646	2.8	0	73.6	39
2	Greenwood	71	<1	840	1.4	0	47.9	16
2	Lee	73	1	620	1.4	0	53.4	20
2	South Boulevard	72	<1	340	0.0	0	50.0	16
5	Sam Leone; Juneway Terrace	76	2.8	600	1.3	0	32.9	14
5	Rogers	76	2.8	490	0.0	0	27.6	11
5	Howard	76	2.8	496	0.0	0	22.4	9
5	Jarvis/Sherwin	76	2.8	528	1.3	0	22.4	8
5	Loyola; Touhy	76	2.8	328	0.0	0	19.7	8
5	Greenleaf	76	2.8	5300	2.6	1	34.2	15
5	Pratt/Farwell	76	2.8	3000	2.6	1	36.8	15
5	Hartigan; N.Shore/Columbia	76	2.8	1600	1.3	0	28.9	13
5	Albion	76	2.8	556	1.3	0	30.3	11
5	Devon	76	2.8	1000	1.3	0	[illegible]	[illegible]

Table 17. (continued) Summary of fecal coliform counts (No./100 mL) at 58 Illinois Lake Michigan beaches, June 17 to September 1, 1984.

Testing Agency	Beaches	Number of Samples	Min.	Max	Percent >500/100 mL	Consecutive[6] Samples >500	Percent >20	Geometric[7,8] Mean
5	Thorndale	76	2.8	2800	1.3	0	36.8	16
5	Ardmore/Hollywood	76	2.8	3200	3.9	0	44.7	20
5	Foster	76	2.8	2800	2.6	0	47.4	22
5	Montrose	76	2.8	4200	2.6	0	46.0	22
5	Fullerton	76	2.8	452	0.0	0	40.8	18
5	Webster	76	2.8	3800	5.3	0	46.0	21
5	Armitage	76	2.8	8000	3.9	0	60.5	39
5	North Ave.	76	2.8	1300	1.3	0	67.1	37
5	Schiller	76	2.8	176	0.0	0	25.0	8
5	Oak St.	76	2.8	352	0.0	0	23.7	9
5	Ohio	76	2.8	460	0.0	0	27.6	12
5	12th St.	76	2.8	548	1.3	0	52.6	29
5	31st St.	76	2.8	444	0.0	0	47.4	19
5	49th St.	76	2.8	72	0.0	0	13.2	7
5	57th St.	76	2.8	302	0.0	0	42.1	18
5	Jackson Park	75	2.8	2000	4.0	0	62.7	35
5	67th St.	76	2.8	2500	1.3	0	40.8	18
5	South Shore	76	2.8	728	1.3	0	59.2	29
5	Rainbow North	76	2.8	248	0.0	0	34.2	12
5	Rainbow South	76	2.8	380	0.0	0	38.2	14
5	Calumet Outer	76	2.8	244	0.0	0	22.4	9
5	Calumet North	76	2.8	604	1.3	0	30.3	13
5	Calumet South	76	2.8	950	1.3	0	48.7	23
	Total	4334	<1	8000	2.0	7	42.0	17

1 North Shore Sanitary District and Lake County Health Department
2 Evanston-North Shore Health Department
3 Village of Winnetka
4 Village of Wilmette
5 Chicago Park District
6 Criteria for closing beaches
7 Lake Michigan Standard 20/100 mL (IPCB, 1982)
8 In calculating geometric means, greater than and less than signs were ignored.

The overall fecal coliform geometric mean for 1984 was 17/100 mL. Individual beach geometric means ranged from 7/100 mL at 49th St. beach to 44/100 mL at Waukegan North beach. The median geometric mean was 20/100 mL found at Lake Bluff, Lee and Ardmore/Hollywood beaches (Table 17). Twenty-seven of the fifty-eight beaches (46.6%) had geometric means which exceeded the 20/100 mL standard. Most of the beaches exceeding the standard are located in northern and southern Lake County and Northern Cook County (Figure 18). Based on the geometric means, the beaches with elevated levels are: Waukegan North (44/100 mL) and Highland Park (34/100 mL) in Lake County; Glencoe (35/100 mL) and Clark (39/100 mL) in northern Cook County; Armitage (39/100 mL) and North Ave. (37/100 mL) in Central Cook County; and Jackson Park (35/100 mL) in Southern Cook County (Table 17 and Figure 18). Two of these beaches, Highland Park (32/100 mL) and Jackson Park (31/100 mL) also exhibited elevated levels in 1983 (Figure 19).

Weekly geometric means for the 58 beaches between June 17 and September 1 (11 weeks) are presented in Table 18. The minimum weekly geometric mean of 2/100 mL was found at Greenwood and Lee beaches for the week of July 1 and at Wilmette beach for the week of July 27. The maximum value of 334/100 mL was found at Highland Park beach on the week of August 5. Forty-five percent of the weekly geometric means exceeded the 20/100 mL standard. There were no violations of the standard at 49th St. beach, while 81.8% of the weekly geometric means exceeded 20/100 mL at Rosewood, Glencoe, North Ave. and Jackson Park beaches. The fewest number of violations were found for the week of July 1 when 10 of 58 beaches (17.2%) exceeded the standard. The highest number of violations were found for the week of August 19 with 50 of the beaches (86.2%)

Figure 18. Illinois Lake Michigan beach fecal coliform geometric means, June 17 to September 1, 1984.

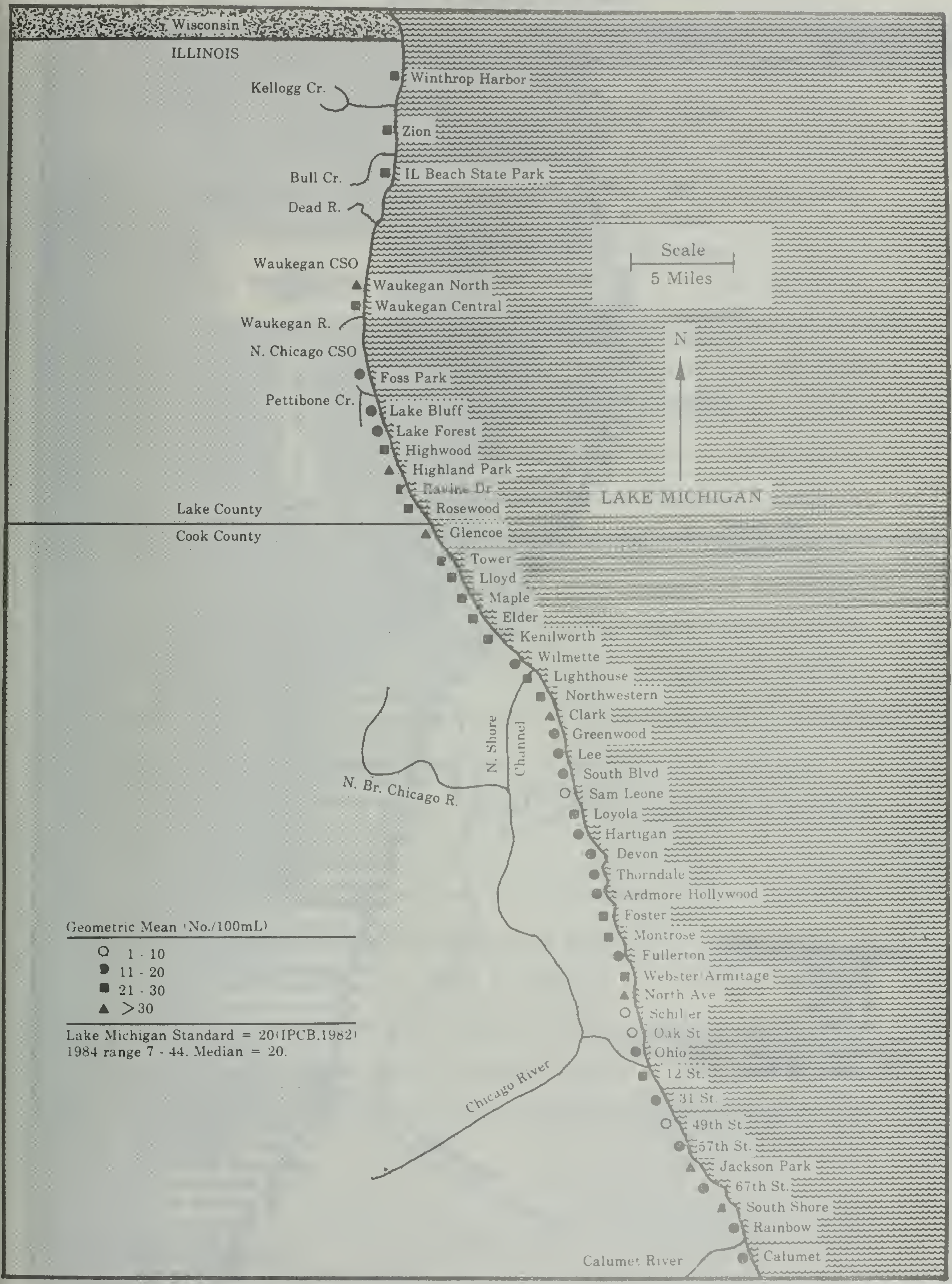
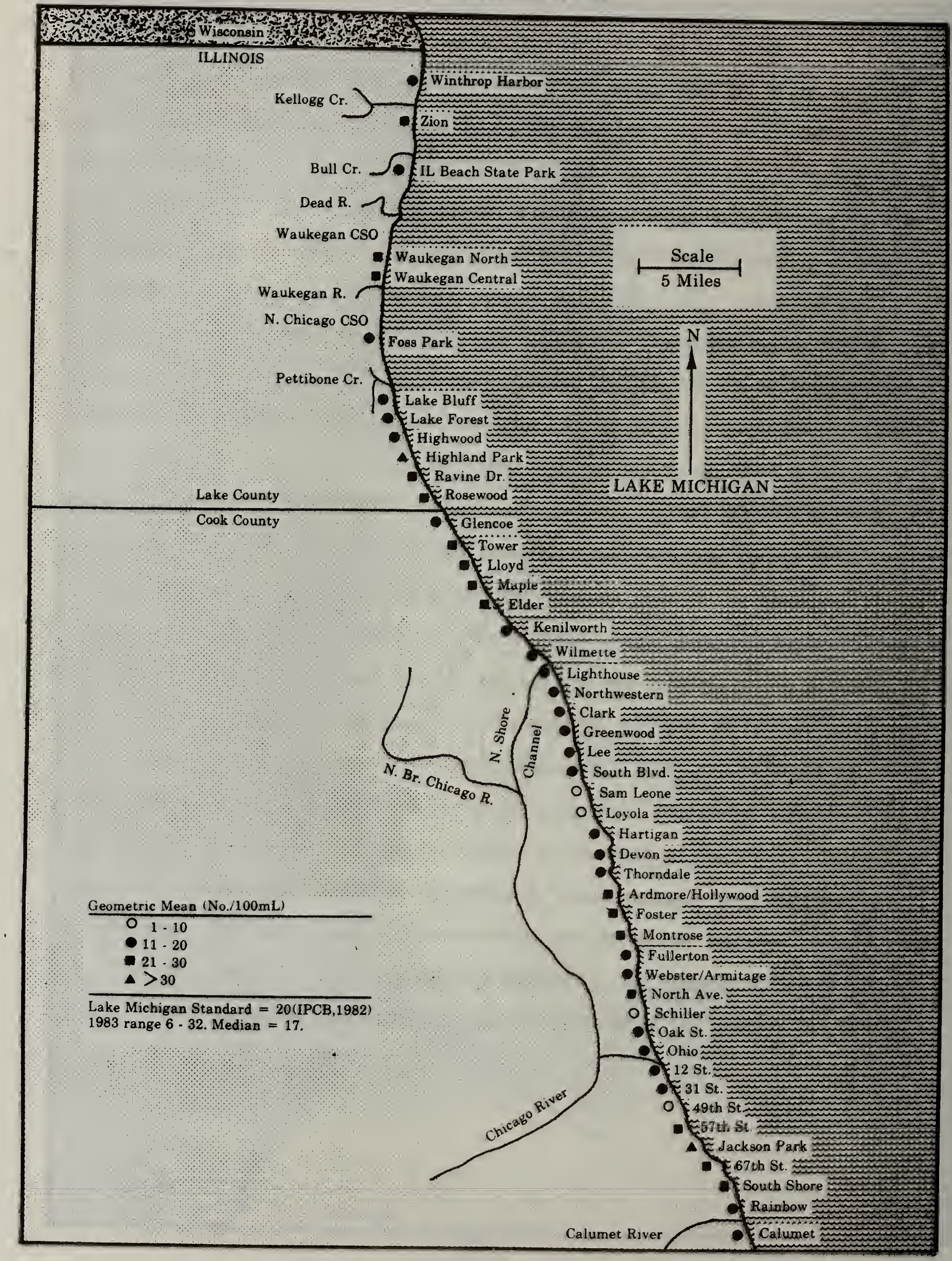


Figure 19. Illinois Lake Michigan beach fecal coliform geometric means, June 6 to September 9, 1983.



exceeding 20/100 mL. Of the 632 weekly geometric mean values, 24 (3.8%) had values greater than 100/100 mL. Fourteen of these 24 values were from the week of August 5, three from June 17, two each from July 22 and August 12 and one each from June 24, July 15 and August 19. Most of these high values, especially from August 5, are probably a result of stormwater runoff and combined sewer overflows (CSOs).

The North Shore Sanitary District's Waukegan and North Chicago Waste Water treatment plants have combined sewers which discharge into Lake Michigan (Figure 18). According to Donahue and Associates (1985), the Waukegan CSO discharged 15 MG from June 22 through June 24 and the North Chicago CSO discharged 1.5 MG on August 7. Waukegan North beach, which is located just south of the Waukegan CSO, appears to have been significantly affected by the discharge (15 MG) in June. The geometric means at Waukegan North for the weeks of June 17 and June 24 were 172/100 mL and 124/100 mL respectively. Other beaches in the immediate area had values less than 24/100 mL during this period (Table 18). Foss Park beach is located just south of the North Chicago CSO. The geometric mean at Foss Park was 120/100 mL for the week of August 5. The discharge of 1.5 MG from the North Chicago CSO on August 7 likely contributed to this high value. However, thirteen other beaches during this period also had high means (Table 18).

During the 1984 swimming season (June 17 to September 1) there were seven instances when a beach exceeded 500/100 mL fecal coliform in consecutive samples. This happened on June 22 and 23 at Ravine Dr. and Rosewood beaches; August 6 and 7 and Greenleaf and Pratt/Farwell beaches; August 7 and 8 at Waukegan North beach; August 9 and 10 and August 30 and 31 at Highland Park beach. Five of the seven violations of the swimming criteria occured in Lake County.

Table 18. Weekly fecal coliform (No./100 ml) geometric means for Illinois Lake Michigan beaches, June 17 to September 1, 1984.

Beaches	No. >20	6/17	6/24	7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26
Winthrop Harbor	6	8	15	24	19	22	20	14	74	27	42	30
Zion	6	14	23	8	38	15	178	12	64	20	38	30
IL.Beach St.Park	9	12	23	24	22	21	89	8	84	32	47	27
Waukegan North	7	172	124	15	15	44	54	19	217	38	37	18
Waukegan Central	5	16	16	20	22	17	41	16	114	21	35	13
Foss Park	4	12	11	12	8	14	31	6	120	25	34	13
Lake Bluff	6	38	31	13	19	10	21	5	59	29	40	10
Lake Forest	5	38	14	22	14	11	22	5	61	14	29	9
Highwood	6	74	19	24	19	12	24	10	49	25	35	10
Highland Park	8	96	23	18	32	17	29	6	334	31	34	52
Ravine Dr.	7	157	14	11	20	28	46	6	75	30	34	23
Rosewood	9	139	35	21	31	30	42	5	128	27	22	12
Glencoe	9	41	25	20	31	26	73	21	39	58	94	15
Tower	8	40	21	10	23	23	37	15	64	37	23	-
Lloyd	6	43	14	17	18	22	40	12	78	29	29	-
Maple	5	36	16	11	14	20	33	19	42	29	24	-
Elder	7	66	14	13	21	21	54	13	49	36	29	-
Kenilworth	7	18	28	12	37	44	45	14	36	33	52	12
Wilmette (Gilson)	1	22	10	13	17	11	6	2	19	13	18	8
Lighthouse	7	16	24	14	21	33	20	22	73	35	52	-
Northwestern Univ.	8	18	29	26	26	8	51	21	82	46	92	5
Clark	8	46	17	4	25	88	105	32	107	72	70	12
Greenwood	4	9	10	2	8	11	29	18	31	49	108	-
Lee	5	7	12	2	13	18	28	25	65	57	65	9
South Boulevard	5	4	8	4	10	33	55	15	23	36	62	6
Juneway Terrace	3	8	7	30	5	10	35	10	20	6	29	19
Rogers	2	6	7	11	7	7	29	6	8	13	26	15
Howard	1	12	7	4	5	6	15	4	11	11	25	10
Jarvis/Sherwin	1	8	8	4	4	4	15	3	13	11	29	11
Touhy	1	12	7	5	6	6	12	4	11	10	21	6
Greenleaf	4	24	11	7	6	17	14	8	77	24	26	8

Table 18. (continued) Weekly fecal coliform (No./100 ml) geometric means[2] for Illinois Lake Michigan beaches, June 17 to September 1, 1984.

Beaches	No. >20[1]	6/17	6/24	7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26
Pratt/Farwell	3	13	37	7	6	8	20	4	109	28	19	12
North Shore/Columbia	4	16	21	6	6	5	8	7	69	31	23	11
Albion	2	19	13	6	4	7	14	5	12	26	20	26
Devon	4	52	12	10	7	5	12	8	55	21	25	13
Thorndale	3	31	15	11	6	6	11	10	110	14	32	13
Ardmore/Hollywood	5	19	5	30	6	10	26	60	70	20	38	19
Foster	6	20	9	20	11	21	34	21	49	32	60	12
Montrose	7	15	8	23	21	8	22	33	53	45	41	17
Fullerton	5	9	6	5	7	8	15	70	88	50	31	28
Webster	5	11	10	4	16	7	14	41	142	126	37	21
Armitage	8	55	12	8	30	15	70	52	150	130	72	30
North Ave.	9	38	7	10	24	24	66	52	111	92	64	48
Schiller	1	3	8	6	7	5	11	4	14	10	24	12
Oak St.	2	5	6	5	8	5	25	5	36	10	18	9
Ohio	3	4	4	9	9	5	15	4	36	21	27	17
12th St.	7	24	14	14	15	26	20	27	110	41	93	30
31st St.	4	18	20	16	13	14	31	10	23	48	41	8
49th St.	0	5	3	6	6	4	7	5	13	12	13	7
57th St.	5	13	9	6	15	12	6	25	68	36	33	32
Jackson Park	9	28	10	24	25	112	31	18	131	25	57	47
67th St.	4	5	6	13	7	17	11	65	112	32	33	19
South Shore	7	4	13	15	16	30	41	59	69	40	92	42
Rainbow North	2	8	7	7	8	14	11	5	27	29	17	16
Rainbow South	4	9	11	9	6	14	11	6	30	26	29	36
Calumet Outer	1	6	6	4	6	9	10	5	52	12	13	14
Calumet North	1	12	7	6	7	18	15	7	78	14	18	11
Calumet South	5	26	51	20	10	20	30	11	52	18	56	12
No. >20	286	22	14	10	16	18	34	16	49	42	50	15

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[1] Lake Michigan Standard 20/100 mL (IPCB, 1982)
[2] Geometric means were not calculated for weeks with fewer than five samples.

There has been a substantial improvement in the water quality of the Lake County beaches since the mid 1970's. Table 19 summarizes the number of times fecal coliform counts exceeded 500/100 mL in two consecutive samples at the twelve beaches from 1970 through 1984. The data from 1970 through 1975 is from the Lake County Health Department (LCHD). Samples from this period were collected only on weekends (Donahue and Associates, 1985). The data from 1976 to 1980 is from the North Shore Sanitary District (NSSD) collected Monday through Friday. The data from 1981 to 1984 includes samples collected by both the NSSD (Mon.-Fri.) and LCHD (Sat. and Sun.). There were 232 instances of consecutive samples exceeding the criteria from 1970 through 1976 and only 44 such instances from 1977 through 1984. The major reason for the improvement was the diversion of the NSSD discharges from Lake Michigan to the DesPlaines River Basin. All flows from Highland Park STP and dry weather flows from Lake Forest STP and Lake Bluff STP were diverted in 1974. Dry weather flows from North Chicago STP and Waukegan STP were diverted in 1976 and 1978 respectively. Wet weather flows from Lake Bluff STP were diverted in 1975 and those from Lake Forest STP in 1978.

Excess wet weather flows are still being discharged into Lake Michigan from the Waukegan and North Chicago STPs. These excess wet weather flows are partially responsible for some of the violations of the swimming criteria at Waukegan North, Waukegan Central and Foss Park beaches. Table 20 compares fecal coliform counts at these beaches with combined sewer overflow events from Waukegan and North Chicago STP from 1980-1984.

Table 19. Number of times the fecal coliform count was over 500/100 mL in two consecutive samples at the Lake County Lake Michigan beaches 1970-1984 .

Beach	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Winthrop Harbor	6	2	6	0	2	0	4	0	0	0	0	0	1	0	0
Zion	6	4	6	0	1	0	1	0	0	0	0	0	1	0	0
Illinois Beach State Park	7	1	4	0	0	0	1	0	0	0	0	0	1	0	0
Waukegan North	3	5	0	1	4	0	0	0	0	0	0	1	0	0	1
Waukegan Central	7	0	0	0	3	0	1	0	0	0	0	0	1	0	0
Foss Park	6	0	2	0	1	0	1	0	0	0	2	1	3	0	0
Lake Bluff	6	0	5	0	1	1	2	0	0	0	1	0	1	0	0
Lake Forest	3	1	2	0	1	0	2	0	1	0	1	0	1	0	0
Highwood	5	2	2	2	7	0	1	0	0	0	0	0	1	1	0
Highland Park (Moraine)	7	2	5	9	10	0	3	0	0	1	3	0	1	3	2
Ravine Drive	10	4	12	-	-	1	5	0	2	0	2	1	2	0	1
Rosewood (Cary Ave.)	6	3	16	2	4	0	5	0	2	0	0	1	2	1	1
Total	72	24	60	14	34	2	26	0	5	1	9	4	15	5	5

Diversion of direct discharges to Lake Michigan to the DesPlaines Basin.
1974: Highland Park STP (all flows), Lake Forest STP (Dry weather flows) and Lake Bluff STP (Dry weather flow)
1975: (October) Lake Bluff STP (Wet weather flows)
1976: (April) North Chicago STP (Dry weather flows)
1978: Lake Forest STP (Wet weather flows) and Waukegan STP (Dry weather flows)

Tabulated data 1970 through 1981 from: Lake County Health Department and North Shore Sanitary District (1981) [Data 1970-1975 LCHD (Sat. & Sun.); 1976-1980 NSSD (Mon.-Fri.); 1981-1984 LCHD (Sat. & Sun.) and NSSD (Mon.-Fri.)]

Table 20. Comparison of combined sewer overflow events from Waukegan and North Chicago WWTP and fecal coliform counts at Waukegan North, Waukegan Central and Foss Park beaches, June-Sept. 1980-1984.

	Fecal Coliform (#/100 mL)[1]			Discharge (MG)[2]	
Date	Waukegan North	Waukegan Central	Foss Park	Waukegan CSO	North Chicago CSO
6/2/80	30	16	18		
6/3/80	162	14	>600		No flow data
6/4/80	15	<2	1070		No flow data
6/5/80	<10	10	1050		No flow data
6/6/80	CBC	10	300	13.7	No flow data
6/7/80				9.29	No flow data
6/8/80				3.07	
6/9/80	80	<2	20	2.39	
6/10/80	260	<2	20		
6/11/80	10	<2	<5		
7/14/80	25	5	<2		
7/15/80	10	<5	2		
7/16/80	380	500	1100		No flow data
7/17/80	10	10	<5		
7/20/80	-	-	-		
7/21/80	4	12	80		No flow data
7/22/80	50	76	125		No flow data
7/23/80	CBC	CBC	180		
7/24/80	110	6	20		
7/25/80	25	4	<2		
7/26/80					No flow data
7/27/80					
7/28/80	70	90	550		
7/29/80	26	4	20		
8/18/80	215	240	130		
8/19/80	3615	3390	>6000		1.83
8/20/80	<20	210	60		
7/12/81	-	-	-		
7/13/81	200	230	120	10.670	
7/14/81	650	120	100	3.280	
7/15/81	60	30	300		
7/16/81	200	140	60		
7/17/81	40	20	5		
7/20/81	12	<2	10		
7/21/81	620	<5	300		
7/22/81	1200	80	40		
7/23/81	100	30	40		
8/3/81	70	>300	55		
8/4/81	55	75	5		0.429
8/5/81	10	5	BNR		0.543
8/6/81	20	20	CBC		1.049
8/7/81	10	15	1650		4.342
8/8/81	130	90	600		1.069
8/9/81	-	-	-		0.280
8/10/81	ABA	5	<5		0.394
8/11/81	5	5	5		0.198
8/12/81	10	10	5		0.250
8/13/81	20	140	<5		0.123
8/14/81	<5	20	60		0.981
8/15/81	60	20	20		0.546
8/16/81	-	-	-		

Table 20. (continued) Comparison of combined sewer overflow events from Waukegan and North Chicago WWTP and fecal coliform counts at Waukegan North, Waukegan Central and Foss Park beaches, June-Sept. 1980-1984.

	Fecal Coliform (#/100 mL)[1]			Discharge (MG)[2]	
Date	Waukegan North	Waukegan Central	Foss Park	Waukegan CSO	North Chicago CSO
8/24/81	<5	6	5		
8/25/81	40	6	20		
8/26/81	50	24	64		1.095
8/27/81	120	400	200		4.381
8/28/81	340	110	>600	41.67	2.171
8/29/81	340	110	260	27.10	5.288
8/30/81	-	-	-	10.27	2.069
8/31/81	390	60	490	2.55	1.570
9/1/81	60	30	200	1.47	1.371
9/2/81	960	30	1400		
9/3/81	70	75	40		0.288
9/4/81	150	75	2800		
7/9/82	<5	<10	5		
7/10/82	10	10	10		0.351
7/11/82	10	10	10		
7/21/82	80	2	<10		
7/22/82	100	44,000	50,000	19.43	5.087
7/23/82	1200	515	34,000	18.07	6.350
7/24/82	90	30	>670	6.22	0.215
7/25/82	60	10	70	1.24	
7/26/82	10	40	<20		
8/3/82	40	5	100		
8/4/82	20	20	1000		2.678
8/5/82	500	690	800		
8/6/82	50	30	100		
1983 (No CSO events, no consecutive samples >500/100 mL)					
6/20/84	320	<2	58		
6/21/84	900	6	<5		
6/22/84	460	330	80	5.60	
6/23/84	>5500	380	20	7.95	
6/24/84	40	40	50	3.94	
6/25/84	860	30	<10		
6/26/84	360	20	<5		
6/27/84	280	5	<5		
6/28/84	20	<5	<5		
8/6/84	86	6	2		
8/7/84	>1500	>1900	ANS		1.50
8/8/84	570	450	ANS		
8/9/84	60	90	500		
8/10/84	CAE	10	490		
8/11/84	340	780	360		
8/12/84	1600	80	70		
8/13/84	70	15	40		

ABA - Container broken in lab
ANS - Not sampled
BNR - Sample contaminated, or improperly contained
CAE - Analytical error
CBC - Confluent growth, interfering organisms

1) North Shore Sanitary District (Mon.-Fri.) and Lake County Health Department (Sat. & Sun.)

2) Donahue and Associates, 1984 and North shore Sanitary District, 1985.

Prior to 1982, the criteria used by the Evanston-North Shore Health Department and the Chicago Park District for the beaches in Cook County was 200/100 mL fecal coliform. Lue Hing et al. (1981) compiled the number of days when fecal coliform counts exceeded 200/100 mL for the Chicago Park District and Evanston-North Shore Health Department beaches from 1970-1980. The report noted a trend toward improved water quality at the Chicago Park District beaches from 1970 to 1980, while the water quality appeared fairly consistant at the Evanston-North Shore Health Department beaches during this period. Fecal coliform values found two days before and three days after a MSDGC lock opening or days in 1981 when the Hammond-Munster Sanitary District Robertsdale Pumping station was discharging were not included.

SECTION E

PESTICIDES, PCB's, METALS AND FISH CONSUMPTION ADVISORIES

Toxics monitoring consisted of analysis of water samples for pesticides, polychlorinated biphenyls (PCB's) and heavy metals. Pesticides and PCB's evaluated in this study belong to a class of compounds known as chlorinated hydrocarbons. Chlorinated hydrocarbons are extremely resistant to biological degradation and are persistent in the environment. In water, chlorinated hydrocarbons become concentrated in aquatic organisms, and these concentrations increase exponentially in those organisms at the top of the food chain. Synthetic chlorinated hydrocarbons evaluated in this study are listed in Table 21.

While most heavy metals and trace elements occur naturally in the environment, extensive use of metals in industry often results in concentrations greatly exceeding natural levels. Certain heavy metals are known to be highly toxic to aquatic organisms and are cumulative in the food chain (Hesse and Evans 1972). Metals evaluated in this study are listed in Tables 23, 24 and 25 along with levels of cyanide and hardness.

Water

Water samples for pesticide and PCB analysis were collected at station 5A on May 30 and November 7 and at stations 5H and 5J on May 16 and October 2, 1984. These stations are part of the National Ambient Water Quality Network or CORE program. Dieldrin and pentachlorophenol were detected at station 5A on May 30 with concentrations of 0.001 ug/L and 0.004 ug/L respectively. The dieldrin concentration was well below the public and food processing water supply standard of 1.0 ug/L (IPCB, 1982). There is presently no standard for

Table 21. Concentrations (ug/L) of chlorinated hydrocarbons in w samples from Lake Michigan stations 5A, 5H, and 5J, May, October, and Nc er, 1984.(2)

Parameters	Stations						Standards[1]
	5A		5H		5J		
	5/30	11/7	5/16	10/2	5/16	10/2	
PCBs	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Aldrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.0
Dieldrin	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	1.0
Total DDT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	50.0
o,p DDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
p,p' DDE	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
o,p DDD	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
p,p' DDD	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
o,p DDT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
p,p' DDT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Total Chlordane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	3.0
Chlordane cis isomer	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Chlordane trans isomer	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nonachlor cis isomer	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Nonachlor trans isomer	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Endrin	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.2
Methoxychlor	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	100
Hexachlorocyclohexane alpha BHC	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
gamma isomer	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Hexachlorobenzene	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Pentachlorophenol	0.004	-	-	<0.001	-	<0.001	-
Toxaphene	-	-	<0.1	-	<0.1	-	5.0

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[1] Public and Food Processing Standard (IPCB, 1982)

[2] Trace organics are recorded by the lab with two different types ess-than (<) codes: U, meaning material was not detected; and M, indicating material fied but not quantified (i.e., detected, but below reporting limit). The param s that were associated with the M less-than code were dieldrin and Chlordane and trans isomers).

Table 22. Number of Lake Michigan water samples above detection levels (ug/L) for chlorinated hydrocarbons 1979 - 1984.

	Detection Levels		Number above detection limit/Number of samples						
Parameter	1979-82	1983-84	1979	1980	1981	1982	1983[a]	1984	Total
PCBs	<0.1	<0.01	0/5	0/4	0/2	0/6	0/2	0/6	0/25
Aldrin	<0.01	<0.001	0/5	0/4	0/2	0/6	0/2	0/6	0/25
Dieldrin	<0.01	<0.001	0/5	0/4	0/2	0/6	1/2[b]	1/6[c]	2/25
Total DDT	<0.01	<0.001	0/5	0/4	0/2	0/6	0/2	0/6	0/25
Total Chlordane	<0.02	<0.002	0/5	0/4	0/2	0/6	1/2[d]	0/6	1/25
Endrin	<0.01	<0.001	0/5	0/4	0/2	0/6	0/2	0/6	0/25
Methoxychlor	<0.05	<0.005	0/5	0/4	0/2	0/6	0/2	0/6	0/25
Hexachlorocyclohexane alpha BHC	<0.01	<0.001	0/0	0/4	0/2	0/6	0/2	0/6	0/20
Lindane	<0.01	<0.001	0/5	0/4	0/2	0/6	0/2	0/6	0/25
Hexachlorobenzene	<0.01	<0.001	0/0	0/4	0/2	0/6	0/2	0/6	0/20
Pentachlorophenol	<0.01	<0.001	0/0	0/0	0/2	3/6[e]	1/2[f]	1/3[g]	5/13
Toxaphene	<1.0	<0.1	0/0	0/0	0/0	0/3	0/2	0/2	0/7
Heptachlor epoxide	<0.01	-	0/5	0/4	0/0	0/0	0/0	0/0	0/9
Heptachlor	<0.01	-	0/5	0/4	0/0	0/0	0/0	0/0	0/9

[a] Samples from 5/17/83 detection level 0.001 ug/L; Samples from 11/1/83 detection level 0.01 ug/l
[b] Dieldrin 0.001 ug/L @ site 5A 5/17/83
[c] Dieldrin 0.001 ug/L @ site 5A 5/30/84
[d] Total Chlordane 0.002 ug/L @ site 5A 5/17/83
[e] Pentachlorophenol 0.14 ug/L @ site 5A, 0.072 ug/L @ 5H and 0.074 ug/L @ 5J 9/8/82
[f] Pentachlorophenol 0.005 ug/L @ site 5A 5/17/83
[g] Pentachlorophenol 0.004 ug/L @ 5A 5/30/84

pentachlorophenol. Dieldrin and pentachlorophenol were below detection limits (<0.001 ug/L) in the remaining samples. The remaining chlorinated hydrocarbons were all below detection limits (Table 21). Since the beginning of this monitoring in 1979, dieldrin has been detected in 2 of 25 samples, total chlordane in 1 of 25 samples and pentachlorophenol in 5 of 13 samples (Table 22). The concentrations of dieldrin and total chlordane were at their detection limits of 0.001 ug/L and 0.002 ug/L respectively. Neither of these compounds were detected until 1983 when the detection limits were lowered by an order of magnitude (Table 22). Detectable concentrations of pentachlorophenol ranged from 0.004 ug/L to 0.14 ug/L with a mean (± SD) of 0.059 (± 0.057) ug/L.

Analysis for cyanide and total metals were conducted on water samples collected at JWPP stations 5A, 5B, 1C, 5C, 5D and 4E on May 30 and July 31, 1984 (Table 23) and at SWPP stations 3F, 5G, 5H, 5I, 2J and 5J on May 16 and October 2, 1984 (Table 24). The results are summarized in Table 25. Cyanide, mercury, beryllium, boron, lead and zinc were below detection limits. Detectable concentrations of arsenic, barium, cadmium, chromium, copper, iron, manganese and nickel were found, with all concentrations well below their general use and public water supply standards. Silver exceeded the general use standard (5.0 ug/L) at site 5J on October 2, with a concentration of 10 ug/L. Other silver concentrations found were 5.0 ug/L at site 4E on May 30 and 4.0 ug/L at site 5G on October 2, the remaining concentrations were below the detection limit (3.0 ug/L). Calcium, magnesium, sodium, potassium, cobalt, strontium, vanadium and aluminum do not have water quality standards. The concentration of these parameters found in 1984 were generally within natural levels.

Table 23. Concentrations of cyanide, hardness and total metals at six Lake Michigan JWPP stations in May and July, 1984.

		Stations											
		5A		5B		1C		5C		5D		4E	
Parameters	Standards	5/30	7/31	5/30	7/31	5/30	7/31	5/30	7/31	5/30	7/31	5/30	7/31
Arsenic (ug/L)	50.0 ug/L[2]	1	2	1	1	<2	<1	<1	<1	1	1	<1	1
Cyanide (mg/L)	0.025 mg/L[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mercury (ug/L)	0.5 ug/L[3]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (mg/L)	-	36	35	35	35	35	36	34	36	35	35	36	36
Magnesium (mg/L)	-	12	11	12	11	12	11	11	11	11	11	12	11
Hardness (mg/L)	-	138	132	135	133	133	136	131	136	135	134	137	135
Sodium (mg/L)	-	6.2	6.2	6.1	6.2	6.2	6.5	6.0	6.5	6.1	6.6	6.4	6.4
Potassium (mg/L)	-	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.2	1.1	1.3	1.2	1.2
Barium (ug/L)	1000.0 ug/L[2]	22	22	21	22	21	22	20	22	21	22	23	23
Beryllium (ug/L)	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Boron (ug/L)	1000.0 ug/L[3]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cadmium (ug/L)	10.0 ug/L[2]	<3	3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chromium (ug/L)	50.0 ug/L[2]	14	6	9	<5	7	<5	5	<5	7	<5	13	<5
Copper (ug/L)	20.0 ug/L[3]	<5	5	<5	<5	<5	<5	<5	<5	<5	<5	5	<5
Cobalt (ug/L)	-	6	<5	<5	<5	<5	<5	<5	<5	<5	<5	7	<5
Iron (ug/L)	1000.0 ug/L[3]	58	<50	<50	<50	88	<50	<50	<50	<50	<50	81	<50
Lead (ug/L)	50.0 ug/L[2]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<100	<50
Manganese (ug/L)	150.0 ug/L[2]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Nickel (ug/L)	1000.0 ug/L[3]	15	6	9	<5	14	<5	10	6	5	<5	16	8
Silver (ug/L)	5.0 ug/L[3]	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	5	<3
Strontium (ug/L)	-	131	127	130	127	130	129	127	128	129	127	133	130
Vanadium (ug/L)	-	6	<5	<5	<5	<5	<5	<5	<5	<5	<5	11	<5
Zinc (ug/L)	1000.0 ug/L[3]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Aluminum (ug/L)	-	87	<50	<50	<50	86	<50	<50	<50	<50	<50	103	<50

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[1] Lake Michigan Standard (IPCB, 1982)
[2] Public and Food Processing Standard (IPCB, 1982)
[3] General Use Standard (IPCB, 1982)

Table 24. Concentrations of cyanide, hardness and total metals at six Lake Michigan SWPP stations May and October, 1984.

		Stations											
		3F		5G		5H		5I		2J		5J	
Parameters	Standards	5/16	10/2	5/16	10/2	5/16	10/2	5/16	10/2	5/16	10/2	5/16	10/2
Arsenic (ug/L)	50.0 ug/L[2]	11	1	5	1	3	2	2	1	1	1	1	1
Cyanide (mg/L)	0.025 mg/L[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mercury (ug/L)	0.5 ug/L[3]	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Calcium (mg/L)	-	36	37	35	32	36	32	36	37	36	32	36	33
Magnesium (mg/L)	-	12	12	12	9.6	12	9.5	12	12	12	9.4	12	9.6
Hardness (mg/L)	-	139	142	137	119	138	118	137	140	138	117	138	120
Sodium (mg/L)	-	5.9	7.1	5.4	5.3	5.2	5.1	5.5	6.9	5.4	5.2	5.4	5.0
Potassium (mg/L)	-	0.99	0.59	0.98	1.4	0.96	1.3	0.97	0.56	0.95	1.4	0.95	1.2
Barium (ug/L)	1000.0 ug/L[2]	21	21	21	25	21	25	21	20	21	24	21	26
Beryllium (ug/L)	-	<0.5	<0.5	<0.5	<3	<0.5	<3	<0.5	<0.5	<0.5	<4	<0.5	<0.5
Boron (ug/L)	1000.0 ug/L[3]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cadmium (ug/L)	10.0 ug/L[2]	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Chromium (ug/L)	50.0 ug/L[2]	<5	5	<5	15	<5	22	<5	5	<5	15	<5	32
Copper (ug/L)	20.0 ug/L[3]	<5	<5	<5	9	<5	7	<5	<5	<5	6	<5	<5
Cobalt (ug/L)	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Iron (ug/L)	1000.0 ug/L[3]	<50	<50	<50	238	<50	101	<50	<50	<50	145	<50	53
Lead (ug/L)	50.0 ug/L[2]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Manganese(ug/L)	150.0 ug/L[2]	<5	<5	<5	11	<5	6	<5	<5	<5	7	<5	<5
Nickel (ug/L)	1000.0 ug/L[3]	<5	7	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Silver (ug/L)	5.0 ug/L[3]	<3	<3	<3	4	<3	<3	<3	<3	<3	<3	<3	10
Strontium (ug/L)	-	126	120	123	135	121	135	124	118	123	133	123	140
Vanadium (ug/L)	-	<5	<5	<5	6	<5	8	<5	<5	<5	<5	<5	12
Zinc (ug/L)	1000.0 ug/L[3]	<50	<100	<100	<50	<50	<50	<50	<50	<50	<50	<50	<50
Aluminum (ug/L)	-	<50	59	<50	124	<50	101	<50	59	<50	124	<50	<50

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[1] Lake Michigan Standard (IPCB, 1982)
[2] Public and Food Processing Standard (IPCB, 1982)
[3] General Use Standard (IPCB, 1982)

Table 25. Summary of cyanide, hardness and total metal concentrations at six Lake Michigan JWPP stations (5A, 5B, 1C, 5C, 5D, 4E) May 30 and July 31 and six SWPP stations (3F, 5G, 5H, 5I, 2J, 5J) May 16 and October 2, 1984.

Parameters	Standard	Number of Samples	Minimum	Maximum	Mean[1]	Standard Deviation	Percent Violation
Arsenic (ug/L)	50 ug/L[2]	24	<1	11	2	2	0
Cyanide (mg/L)	0.025 mg/L[3]	24	0.00	0.00	0.00	0.0	0
Mercury (ug/L)	0.5 ug/L[4]	24	<0.10	<0.10	<0.10	0.0	0
Calcium (mg/L)	-	24	32	37	35	1	-
Magnesium (mg/L)	-	24	9.4	12	11.2	0.9	-
Hardness (mg/L)	-	24	118	142	133	7	-
Sodium (mg/L)	-	24	5.0	7.1	6.0	0.6	-
Potassium (mg/L)	-	24	0.56	1.4	1.1	0.2	-
Barium (ug/L)	1000 ug/L[2]	24	20	26	22	2	0
Beryllium (ug/L)	-	24	<0.5	<3	<0.5	0.5	-
Boron (ug/L)	1000 ug/L[4]	24	<50	<50	<50	0	0
Cadmium (ug/L)	10 ug/L[2]	24	<3	3	<3	0.3	0
Chromium (ug/L)	50 ug/L[2]	24	<5	32	11	20	0
Copper (ug/L)	20 ug/L[4]	24	<5	9	<5	2	0
Cobalt (ug/L)	-	24	<5	7	<5	1	-
Iron (ug/L)	1000 ug/L[4]	24	<50	238	50	51	0
Lead (ug/L)	50 ug/L[2]	24	<50	<100	<50	5	0
Manganese (ug/L)	150 ug/L[2]	24	<5	11	<5	2	0
Nickel (ug/L)	1000 ug/L[4]	24	<5	16	5	4	0
Silver (ug/L)	5.0 ug/L[4]	24	<3	10	<3	2	4
Strontium (ug/L)	-	24	118	140	128	5	-
Vanadium (ug/L)	-	24	<5	12	<5	3	-
Zinc (ug/L)	1000 ug/L[4]	24	<50	<100	<50	7	0
Aluminum (ug/L)	-	24	<50	124	<50	36	-

[1] Values below detection levels were arbitrarily assigned a value 1/2 the detection limit for purposes of calculating the mean.

[2] Public and Food Processing Water Supply Standard (IPCB, 1982)

[3] Lake Michigan Standard (IPCB, 1982)

[4] General Use Standard (IPCB, 1982)

Fish Consumption Advisories

Chemical contaminants are often found in our environment and some reach lakes and streams where they accumulate in sediments, aquatic organisms and fish. Consumption of contaminated fish can represent a major source of chemical exposure for humans. All Lake Michigan fish are contaminated to some extent with PCBs, pesticides or other toxic substances.

In general, fish which contain more toxic chemicals than permitted under current Food and Drug Administration action levels should not be eaten or sold for human consumption. It should be noted that any food containing fat soluble contaminants such as PCB or DDT potentially represents an additional exposure to toxic chemicals which accumulate in the human body, concentrate in breast milk and therefore, represent some degree of risk. Long term risks to health are not well defined at this time. Sport caught fish, even those with low contaminant levels, can represent a major source of exposure if eaten often enough. Women who might breast feed should not make Lake Michigan fish a major part of their regular diet. Elminating or reducing your frequency of consumption or eating smaller sized fish can also reduce your degree of exposure and accordingly any health risks which may be associated with exposure.

To provide uniform advisories on this subject, health officials from the states of Illinois, Indiana, Michigan and Wisconsin in cooperation with the Environmental Protection Agency's, Great Lakes National program office have jointly reviewed all available contaminant monitoring data for Lake Michigan sport fish.

Popular sport fish species from Lake Michigan were evaluated on the basis of whether or not these fish comply with the PCB, DDT, Chlordane and Dieldrin action levels established by the U.S. Food and Drug Administration to regulate the commerical sale of fish and shellfish.

The following advice is provided concerning consumption of Lake Michigan sport fish:

Group I - Fish with the Lowest Level of Contaminants

Eating Group I fish poses the lowest risk of exposure to contaminants. (90% or more of the fish tested in Group I met Food and Drug Administration action levels).

Group II - Fish with Moderate Levels of Contaminants

Pregnant women, women who expect to bear children, nursing mothers and young children should not eat these fish. Others should limit their consumption to no more than one meal per week and heed preparation and cooking recommendations. (One or more contaminants were found to be above the Food and Drug Administration action level in 50% or more of the fish tested in Group II).

Group III - Fish with High Levels of One or More Contaminants

NO ONE should eat Group III fish. (One or more contaminants were found to be above the Food and Drug Administration action levels in 90% or more of the fish tested in Group III).

Table 26. Lake Michigan sport fish grouped according to levels of contaminants.[1]

GROUP I LOW	GROUP II MEDIUM	GROUP III HIGH
Yellow Perch	Chinook salmon (over 25")[2]	Brown trout[3]
Smelt	Lake trout (20"-25")	Lake trout (over 25")
Coho salmon		Carp
Rainbow trout		
Lake trout (less than 20")		

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[1] Based on the presence of lipid soluble contaminants such as PCB, DDT, Dieldrin Chlordane or Toxaphene. Heavy metal contaminant levels are not significant.

[2] Not enough samples of brook trout or chinook salmon less than 25" have been collected to adequately establish contaminant levels.

[3] Brown trout contained only PCBs and showed a wide range in levels from location-to-location.

Table 27. Food and Drug Administration action levels for contaminants in fish.

Chlordane	0.3 parts per million
DDT/DDE	5.0 parts per million
Dieldrin	0.3 parts per million
PCB	2.0 parts per million

Those who do consume sport caught fish should prepare and cook these fish in ways which will reduce the presence of fat soluble contaminants in the edible portion. These techniques include removal of the skin and fatty tissue associated with the belly, lateral line and dorsal area of large fish and cooking by baking, broiling on a rack or barbecuing so the fatty oil can drip away from the finished meal.

Fish monitoring data for Lake Michigan show that levels of most fish contaminants are declining. However, new contaminants are also being identified. Therefore, additional monitoring will be necessary in the future, and advisories will be periodically modified as changes in information occur.

Persons interested in the most recent information or information specific for the area in which they wish to fish should contact their State Departments of Public Health, Conservation and/or Environmental Protection.

SECTION F

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APPENDIX I

SURVEY
DATA
SHEETS

CITY OF CHICAGO
WATER PURIFICATION DIVISION

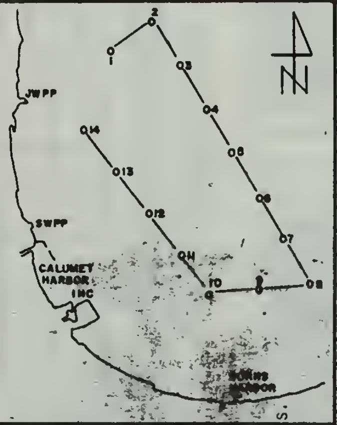
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 28.

CHICAGO-LAKE MICHIGAN OPEN WATER SURVEY

DATE April 24, 19 84



METEOROLOGICAL DATA								
TIME		0800	0900	1000	1100	1200	1300	1400
DIRECTION	00036	N	W	NW	SE	SE	W	W
VELOCITY	00035	10	7	8	8	9	14	14

PREVAILING WIND
00036
W

SURVEY BY: J. Vencill / K. Rudmin

REMARKS:
Near calm w/light and variable winds, overcast until sample station 12
Asbestos samples at even numbered stations.

PARAMETER	STORET NUMBER	SAMPLING POINT AND STATION NUMBER													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		CHW201	CHW202	CHW203	CHW204	CHW205	CHW206	CHW207	CHW208	CHW209	CHW210	CHW211	CHW212	CHW213	CHW214
TIME		0901	0919	0937	0935	1013	1031	1049	1107	1125	1143	1201	1219	1237	1255
TEMPERATURE °C	00010	3	3	3	2	2	2	3	3	3	3	4	3	3	3
TURBIDITY F.T.U.	00076	1.3	0.80	0.55	0.45	0.45	0.55	0.75	0.75	1.3	0.90	0.85	1.0	0.60	0.90
ODOR, THRESHOLD	00086	2 DM	1M	1M	1M	1M	1M	1M	1M	2M	1M	1M	1M	1M	1M
pH	00400	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
SULFATE mg/L	00945	21.8	21.8	23.8	21.3	21.0	21.5	21.3	21.3	21.0	21.0	21.0	21.5	21.0	21.0
CHLORIDE mg/L	00940	9.8	9.0	9.0	9.0	9.0	9.3	9.2	9.1	9.7	9.8	9.7	10.1	10.1	10.3
PHOSPHATE, TOTAL mg/L	00650	<0.01	0.03	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.01	0.02
PHOSPHATE, DISSOLVED mg/L	00653	<0.01	0.01	0.01	<0.01	<0.01	0.01	< 0.01	0.01	0.01	<0.01	<0.01	0.01	0.01	0.01
SILICA mg/L	00956	0.40	0.40	0.40	0.40	0.45	0.45	0.35	0.37	0.30	0.27	0.30	0.35	0.40	0.37
POTASSIUM mg/L	00937	1.4	1.5	1.5	1.4	1.4	1.5	1.5	1.5	1.4	1.4	1.5	1.4	1.4	1.4
SODIUM mg/L	00929	4.5	4.5	4.5	4.5	4.7	4.6	4.6	4.5	4.5	4.5	4.5	4.5	4.3	4.5
CONDUCTIVITY µ mhos	00095	285	280	285	290	290	285	290	285	300	295	295	290	290	295
RESIDUE, FILTRABLE mg/L	00515	157	146	142	137	142	142	142	144	145	141	141	141	142	138
RESIDUE, NONFILTRABLE mg/L	00530	4	3	2	3	2	3	3	3	3	4	3	3	3	3
OXYGEN DEMAND, CHEMICAL mg/L	00335	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01	0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.28	0.29	0.29	0.30	0.30	0.30	0.30	0.29	0.28	0.29	0.29	0.29	0.30	0.30
NITROGEN, ORGANIC mg/L	00605	0.16	0.16	0.16	0.16	0.12	0.16	0.12	0.12	0.16	0.16	0.12	0.12	0.16	0.16
PLATE COUNT 48hr, 35°C PER mL	31753	2	5	1	1	2	1	5	0	1	6	2	2	0	1
MF-TC PER 100 mL	31503	0	0	0	0	0	0	0	0	0	0	0	2	0	0
MF-FC PER 100 mL	31616	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLANKTON PER mL	60050	1290	510	570	1020	960	990	840	1350	1680	1020	2820	1560	750	1140
ACTINOS 14 DAY, 25°C PER mL	80148	0.0	0.3	0.4	0.1	0.5	0.1	0.1	0.1	0.2	0.9	0.2	0.3	0.2	0.3
FUNGI PER mL	31856	0.2	0.6	0.4	1.5	0.8	0.5	0.8	0.9	1.2	1.0	1.5	1.2	0.7	0.9
ASBESTOS PER L	00948	-	2.12×10^5	-	1.85×10^5	-	1.89×10^5	-	2.91×10^5	-	3.33×10^5	-	2.51×10^5	-	2.01×10^5

Table 29.

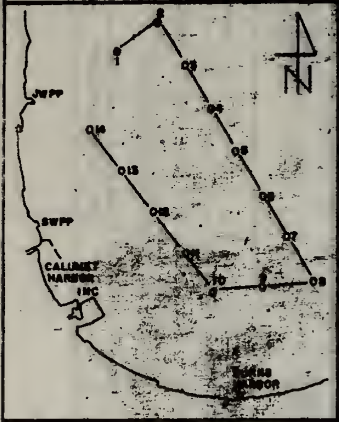
CITY OF CHICAGO
WATER PURIFICATION DIVISION

DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

CHICAGO-LAKE MICHIGAN OPEN WATER SURVEY

DATE June 19, 19 1984



PARAMETER	STORET NUMBER	1 CHW201	2 CHW202	3 CHW203	4 CHW204	5 CHW205	6 CHW206	7 CHW207	8 CHW208	9 CHW209	10 CHW210	11 CHW211	12 CHW212	13 CHW213	14 CHW214
TIME		0900	0918	0936	0954	1012	1030	1048	1106	1124	1142	1200	1218	1236	1254
TEMPERATURE °C	00010	15	14	14	14	14	15	15	15	15	15	15	15	15	15
TURBIDITY F.T.U.	00076	0.40	0.35	0.30	0.30	0.25	0.35	0.30	0.25	0.30	0.35	0.30	0.30	0.30	0.30
ODOR, THRESHOLD	00086	2DF	1DF	1DM	1M	1M	1M	1M	2DM	1M	1M	1M	1M	1M	1M
pH	00400	8.5	8.5	8.5	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.5	8.5
SULFATE mg/L	00945	21.5	21.5	21.0	21.0	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5
CHLORIDE mg/L	00940	8.5	8.5	8.6	8.5	8.5	8.6	8.6	8.6	8.7	8.6	8.7	8.6	8.7	8.7
PHOSPHATE, TOTAL mg/L	00650	0.02	<0.01	0.01	<0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.03
PHOSPHATE, DISSOLVED mg/L	00653	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	0.01
SILICA mg/L	00956	0.30	0.35	0.35	0.43	0.42	0.40	0.35	0.35	0.33	0.35	0.38	0.33	0.33	0.32
POTASSIUM mg/L	00937	1.4	1.5	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.4
SODIUM mg/L	00929	5.2	5.2	5.1	5.2	5.2	5.2	5.3	5.3	5.3	5.3	5.3	5.4	5.3	5.3
CONDUCTIVITY μmhos	00095	270	280	280	275	290	290	285	290	290	290	290	290	285	285
RESIDUE, FILTRABLE mg/L	00515	162	160	160	158	159	160	160	161	161	159	157	156	158	158
RESIDUE, NONFILTRABLE mg/L	00530	2	2	2	2	2	2	2	2	2	2	1	2	2	1
OXYGEN DEMAND, CHEMICAL mg/L	00335	<5	<5	<5	5.0	<5	6.5	<5	<5	<5	<5	<5	<5	<5	<5
NITROGEN, AMMONIA mg/L	00610	<0.01	0.02	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03
NITROGEN, NITRITE-NITRATE mg/L	00630	0.24	0.26	0.27	0.25	0.25	0.26	0.27	0.27	0.27	0.26	0.26	0.27	0.26	0.27
NITROGEN, ORGANIC mg/L	00605	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.14	0.14	0.20	0.14	0.20
PLATE COUNT 48hr, 35°C PER mL	31753	0	0	0	3	0	0	0	0	0	0	0	0	0	0
MF-TC PER 100 mL	31503	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FC PER 100 mL	31616	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLANKTON PER mL	60050	1710	1680	1620	1290	2040	1800	1950	2370	1590	750	690	1050	1560	930
ACTINOS 14 DAY, 26°C PER mL	80148	0	0	0	0	0.1	0.1	0.1	0	0	0	0	0	0.2	0
FUNGI PER mL	31856	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0
ASBESTOS PER L	00948	-	2.31×10^5	-	1.42×10^5	-	2.51×10^5	-	2.43×10^5	-	2.39×10^5	-	3.54×10^5	-	3.84×10^5

METEOROLOGICAL DATA

TIME		0800	0900	1000	1100	1200	1300	1400
DIRECTION	00036	N	N	N	N	N	N	N
VELOCITY	00035	10	10	10	12	11	10	8

PREVAILING WIND	SURVEY BY: J. VENCILL/K. RUDMIN
00036	REMARKS: SUNNY WITH HIGH CIRRUS CLOUDS WAVES L - 2' NO SWELLS.
N.	

TABLE 30.

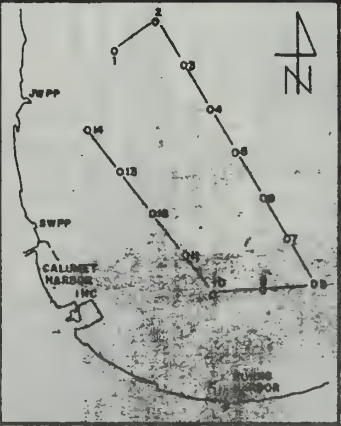
CITY OF CHICAGO
WATER PURIFICATION DIVISION

DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

CHICAGO-LAKE MICHIGAN OPEN WATER SURVEY

DATE September 19, 1984



METEOROLOGICAL DATA								
TIME		0800	0900	1000	1100	1200	1300	1400
DIRECTION	00036	W	NW	W	W	SW	SE	SE
VELOCITY	00035	24	19	14	10	9	9	11
PREVAILING WIND	SURVEYED BY: J. Vencil, K. Rudmin							
ODORS	REMARKS: Sunny with some haze; waves 1-3'; air temperatures in the upper seventies							
W								

PARAMETER	STORET NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		CHW201	CHW202	CHW203	CHW204	CHW205	CHW206	CHW207	CHW208	CHW209	CHW210	CHW211	CHW212	CHW213	CHW214
TIME		0905	0923	0941	0953	1017	1035	1053	1111	1129	1147	1205	1223	1241	1259
TEMPERATURE °C	00010	15	17	17	17	17	17	17	17	17	17	17	17	17	17
TURBIDITY F.T.U.	00076	0.35	0.55	0.55	0.60	0.50	0.60	0.60	0.65	0.75	0.65	0.75	0.65	0.60	0.65
ODOR, THRESHOLD	00086	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M
pH	00400	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
SULFATE mg/L	00945	23.0	21.8	21.5	21.5	21.5	21.5	21.5	22.3	22.0	22.0	22.0	21.5	22.0	22.0
CHLORIDE mg/L	00940	9.1	9.0	9.0	9.4	9.0	8.9	9.0	9.0	9.0	8.8	9.0	9.0	9.0	9.4
PHOSPHATE, TOTAL mg/L	00650	0.02	0.01	0.01	<0.01	0.02	0.02	0.02	<0.01	<0.01	<0.01	0.01	0.01	0.01	0.01
PHOSPHATE, DISSOLVED mg/L	00653	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SILICA mg/L	00956	0.65	0.40	0.40	0.39	0.33	0.33	0.37	0.43	0.50	0.45	0.45	0.48	0.40	0.37
POTASSIUM mg/L	00937	1.4	1.3	1.4	1.4	1.4	1.3	1.4	1.3	1.3	1.4	1.3	1.4	1.4	1.2
SODIUM mg/L	00929	4.9	4.8	4.7	4.9	5.0	5.0	4.8	4.8	4.7	5.0	5.0	5.0	5.1	4.7
CONDUCTIVITY µmhos	00095	285	285	285	285	285	285	285	285	285	280	280	280	280	280
RESIDUE, FILTRABLE mg/L	00515	157	160	152	160	156	155	157	159	157	158	164	162	154	158
RESIDUE, NONFILTRABLE mg/L	00530	5	3	3	4	3	3	4	2	3	3	3	3	3	3
OXYGEN DEMAND, CHEMICAL mg/L	00335	11.0	<5	5.9	5.6	7.6	9.2	6.3	<5	6.3	8.2	6.3	6.6	<5	5.9
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.26	0.22	0.23	0.22	0.22	0.22	0.22	0.23	0.24	0.25	0.25	0.24	0.23	0.25
NITROGEN, ORGANIC mg/L	00605	0.12	0.12	0.12	0.10	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.14	0.12	0.12
PLATE COUNT 48hr, 35°C PER mL	31753	4	5	1	1	2	0	1	3	4	1	1	1	3	1
MF-TC PER 100 mL	31503	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FC PER 100 mL	31616	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLANKTON PER mL	60050	180	120	510	90	150	330	300	540	330	90	180	300	370	300
ACTINOS 14 DAY, 26°C PER mL	80148	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
FUNGI PER mL	31856	0.2	0.4	0.3	2.0	1.0	0.1	0.8	0.0	0.1	0.2	1.0	0.2	1.0	0.3
ASBESTOS PER L	00948	-	1.88×10^5	-	2.95×10^5	-	1.85×10^5	-	1.81×10^5	-	2.35×10^5	-	2.79×10^5	-	2.87×10^5

TABLE 31.

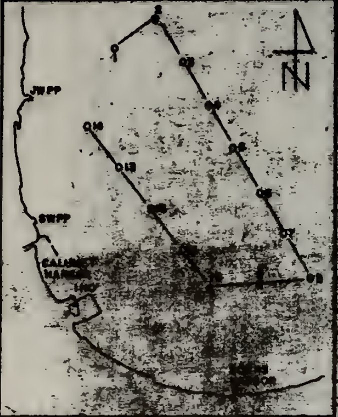
CITY OF CHICAGO
WATER PURIFICATION DIVISION

DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

CHICAGO-LAKE MICHIGAN OPEN WATER SURVEY

DATE DECEMBER 5, 19 84



		SAMPLING POINT AND STATION NUMBER													
PARAMETER	STORET NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		CHW201	CHW202	CHW203	CHW204	CHW205	CHW206	CHW207	CHW208	CHW209	CHW210	CHW211	CHW212	CHW213	CHW214
TIME		0905	0923	0941	0959	1017	1035	1053	1111	1129	1147	1200	1218	1236	1254
TEMPERATURE °C	00010	4	4	4	4	4	4	4	4	4	4	4	4	4	4
TURBIDITY F.T.U.	00076	0.40	0.35	0.30	0.30	0.30	0.30	0.35	0.40	0.40	0.35	0.40	0.45	0.45	0.60
ODOR, THRESHOLD	00086	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M
pH	00400	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	3.3	8.3
SULFATE mg/L	00945	21.0	20.8	20.8	21.0	21.0	21.0	21.5	21.0	21.0	21.5	21.0	21.0	21.0	21.0
CHLORIDE mg/L	00940	10.1	10.5	10.5	10.0	10.1	10.2	10.0	10.0	10.1	9.2	9.3	9.2	9.2	9.2
PHOSPHATE, TOTAL mg/L	00650	0.06	0.05	0.05	0.05	0.02	0.04	0.02	0.03	0.05	0.01	0.04	0.05	0.01	0.02
PHOSPHATE, DISSOLVED mg/L	00653	0.02	<0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	<0.01	0.03	0.01	<0.01	<0.01
SILICA mg/L	00956	1.0	0.98	0.95	1.0	0.96	1.0	1.0	1.0	1.02	1.03	1.05	0.98	1.03	1.03
POTASSIUM mg/L	00937	1.4	1.4	1.5	1.4	1.4	1.5	1.3	1.3	1.5	1.5	1.5	1.4	1.4	1.5
SODIUM mg/L	00929	4.5	4.5	4.5	4.4	4.5	4.4	4.4	4.5	4.5	4.5	4.3	4.4	4.3	4.3
CONDUCTIVITY µ mhos	00095	265	285	295	290	285	280	290	285	290	290	285	280	270	280
RESIDUE, FILTRABLE mg/L	00515	170	164	170	168	147	162	169	173	174	168	167	165	163	164
RESIDUE, NONFILTRABLE mg/L	00530	3	2	2	1	1	0	1	2	2	2	1	2	1	1
OXYGEN DEMAND, CHEMICAL mg/L	00335	<5	<5	<5	5.6	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.29	0.29	0.29	0.30	0.30	0.30	0.30	0.29	0.30	0.29	0.30	0.29	0.29	0.28
NITROGEN, ORGANIC mg/L	00605	0.12	0.12	0.12	0.10	0.10	0.10	0.10	0.12	0.10	0.12	0.12	0.12	0.12	0.12
PLATE COUNT 48hr, 35°C PER mL	31753	8	3	12	9	3	1	10	4	4	5	9	3	2	3
MF-TC PER 100 mL	31503	0	0	0	0	0	0	0	0	2	0	0	0	0	0
MF-FC PER 100 mL	31616	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLANKTON PER mL	60050	960	180	120	240	300	630	210	30	90	90	540	330	120	150
ACTINOS 14 DAY, 26°C PER mL	80148	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FUNGI PER mL	31856	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	1.0	0.0	1.0	0.0
ASBESTOS PER L	00948	-	1.37×10^5	-	1.69×10^5	-	2.51×10^5	-	2.91×10^5	-	3.10×10^5	-	2.83×10^5	-	3.22×10^5

METEROLOGICAL DATA

TIME		0800	0900	1000	1100	1200	1300
DIRECTION	00036	S	S	S	S	S	S
VELOCITY	00035	15	14	12	11	11	9

PREVAILING WIND
00036
S

SURVEY BY: J. VENCILL/K. RUDMIN

REMARKS: OVERCAST W/MODERATE TO LARGE SWELLS - GALE WARNINGS ISSUED FOR EARLY AFTERNOON - MODERATE TO SEVERE ICING PROBLEMS

CITY OF CHICAGO
WATER PURIFICATION DIVISION

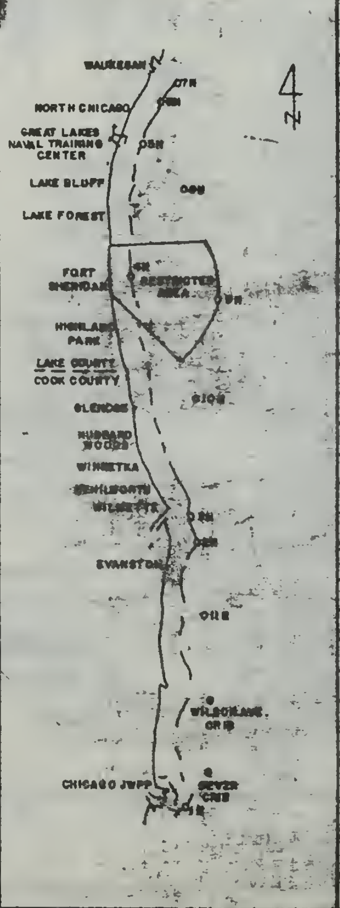
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 32.

NORTH SHORE LAKE SURVEY

DATE MAY 8, 19 84



PARAMETER	STORET NUMBER	1N CHW013	2N CHW011	3N CHW010	5N CHW005	6N CHW004	7N CHW003	8N CHW006	9N CHW008	10N CHW009	11N CHW012
TIME		0830	0935	0942	1106	1113	1125	1048	1025	1004	0911
TEMPERATURE °C	00010	8	7	7	6	6	7	5	5	6	8
TURBIDITY F.T.U.	00076	3.6	2.9	2.1	4.6	4.5	4.5	1.4	1.9	2.1	5.3
ODOR, THRESHOLD	00086	2M	2M	1M	1M	1M	2M	1M	1M	1M	1M
pH	00400	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
SULFATE mg/L	00945	22.5	22.0	21.5	22.0	21.5	22.0	21.5	21.0	22.0	22.5
CHLORIDE mg/L	00940	9.4	9.1	9.0	9.1	9.0	9.5	8.5	8.6	9.1	10.2
PHOSPHATE, TOTAL mg/L	00650	0.02	0.03	0.02	0.03	0.03	0.02	0.04	0.02	0.02	0.02
PHOSPHATE, DISSOLVED mg/L	00653	<0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
CONDUCTIVITY µ mhos	00095	290	295	295	295	295	290	290	290	280	295
RESIDUE, NONFILTRABLE mg/L	00530	1	1	1	3	1	3	0	0	1	3
OXYGEN DEMAND, CHEMICAL mg/L	00335	7.6	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NITROGEN, AMMONIA mg/L	00610	<0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.27	0.31	0.32	0.31	0.31	0.34	0.31	0.30	0.30	0.34
NITROGEN, ORGANIC mg/L	00605	0.24	0.22	0.22	0.24	0.24	0.20	0.24	0.24	0.24	0.24
PHENOL-LIKE SUBSTANCES µg/L	32730	< 1	-	< 1	< 1	-	< 1	-	< 1	-	< 1
PLATE COUNT 48 hr., 35°C PER mL	31753	380	12	8	6	6	15	6	8	3	8
MF-TC PER 100mL	31503	0	0	0	0	0	4	0	0	0	0
MF-FC PER 100mL	31616	0	0	0	0	0	0	0	0	0	0
MF-FS PER 100 mL	31679	0	-	0	0	-	0	-	0	-	0
PLANKTON, PER mL	60050	6630	6540	6630	8250	6840	3750	5160	3690	4020	4800
ACTINOS 14 DAY, 20°C PER mL	80148	1.1	0.9	1.7	0.8	1.0	0.2	0.4	0.8	1.0	0.3
FUNGI PER mL	31856	8	7	4	5	2	2	1	3	9	6

METEOROLOGICAL DATA

							PREVAILING WIND
TIME		0800	0900	1000	1100	1200	00036
DIRECTION	00036	NW	W	NW	NW	NW	
VELOCITY	00035	15	16	14	16	19	NW

SURVEY BY: J. VENCILL / M. OSMAN

REMARKS: OVERCAST WITH 15-20 MPH WINDS FROM WEST/NORTHWEST; WAVES 3-4 FEET WITH MODERATE TO HEAVY SWELLS.

CITY OF CHICAGO
WATER PURIFICATION DIVISION

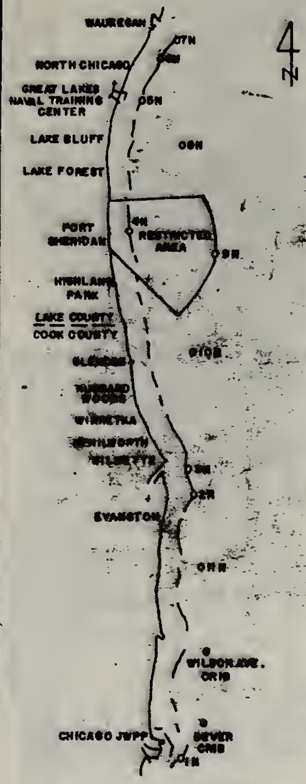
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 33.

NORTH SHORE LAKE SURVEY

DATE JUNE 12, 1984



PARAMETER	STORET NUMBER	1N CHW013	2N CHW011	3N CHW010	5N CHW005	6N CHW004	7N CHW003	8N CHW006	9N CHW008	10N CHW009	11N CHW012	
TIME		0828	0926	0933	1059	1106	1116	1037	1014	0955	0908	
TEMPERATURE °C	00010	14	14	14	13	13	13	11	12	12	13	
TURBIDITY F.T.U.	00076	0.90	0.60	0.55	0.45	0.50	0.50	0.40	0.45	0.45	0.60	
ODOR, THRESHOLD	00086	1DF	1M	1M	1M	2M	1M	1M	1M	2M	2M	
pH	00400	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	
SULFATE mg/L	00945	20.8	20.3	21.5	20.5	20.3	20.8	20.5	20.5	21.0	20.5	
CHLORIDE mg/L	00940	8.6	8.5	8.9	8.5	8.5	8.5	8.6	8.5	8.6	8.5	
PHOSPHATE, TOTAL mg/L	00650	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.02	
PHOSPHATE, DISSOLVED mg/L	00653	0.04	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	
CONDUCTIVITY μ mhos	00095	295	295	295	295	295	295	295	295	295	295	
RESIDUE, NONFILTRABLE mg/L	00530	0	0	0	0	1	3	0	0	0	0	
OXYGEN DEMAND, CHEMICAL mg/L	00335	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
NITROGEN, NITRITE-NITRATE mg/L	00630	0.24	0.24	0.23	0.25	0.26	0.27	0.27	0.26	0.26	0.26	
NITROGEN, ORGANIC mg/L	00605	0.20	0.28	0.20	0.20	0.24	0.20	0.20	0.20	0.20	0.28	
PHENOL-LIKE SUBSTANCES μg/L	32730	<1	-	<1	<1	-	<1	-	<1	-	<1	
PLATE COUNT 48 hr., 35 °C PER mL	31753	220	0	0	0	1	0	0	0	0	0	
MF-TC PER 100 mL	31503	0	0	0	0	0	0	0	0	0	0	
MF-FC PER 100 mL	31616	0	0	0	0	0	0	0	0	-	0	
MF-FS PER 100 mL	31679	0	-	0	0	-	0	-	0	-	0	
PLANKTON PER mL	60050	750	2220	1500	2310	750	300	2880	450	3540	3210	
ACTINOS 14 DAY, 28°C PER mL	60148	1.0	0	1.0	0	0.1	0.1	0.2	0	0.5	0	
FUNGI PER mL	31856	0	0.1	1.0	1.0	0	0	0	0	2.0	1.0	

METEOROLOGICAL DATA									PREVAILING WIND
TIME		0800	0900	1000	1100	1200			00036
DIRECTION	00036	SW	SW	SW	SW	SW			SW
VELOCITY	00035	12	12	14	14	16			

SURVEY BY: J. VENCILL/K. RUDMIN

REMARKS: SUNNY W/HAZE. WAVES 1 -2'
NO SWELLS
VERY WINDY FROM OFF SHORE

CITY OF CHICAGO
WATER PURIFICATION DIVISION

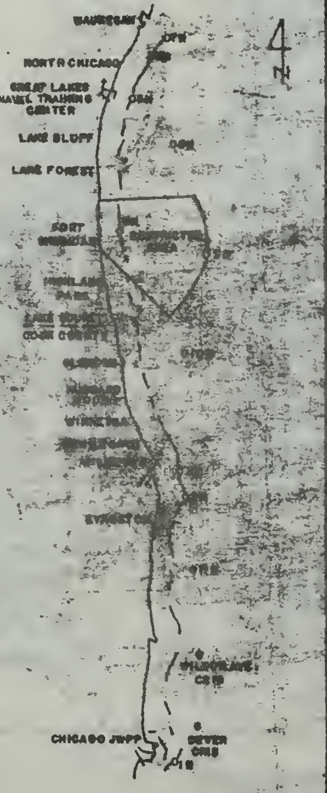
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 34.

NORTH SHORE LAKE SURVEY

DATE JULY 17, 1984



PARAMETER	STORET NUMBER	1N CHW013	2N CHW011	3N CHW010	5N CHW005	6N CHW004	7N CHW003	8N CHW006	9N CHW008	10N CHW009	11N CHW012	
TIME		0837	0936	0943	1105	1112	1124	1045	1024	1005	0923	
TEMPERATURE °C	00010	17	16	17	15	11	11	18	17	18	16	
TURBIDITY F.T.U.	00076	0.80	0.45	0.45	0.45	0.55	0.95	0.40	0.40	0.30	0.55	
ODOR THRESHOLD	00086	2 DF	1M	2M	1M	1M	2 DF	1M	1M	1M	1M	
pH	00400	8.6	8.6	8.6	8.6	8.5	8.4	8.6	8.6	8.6	8.6	
SULFATE mg/L	00945	22.0	22.0	21.5	22.0	21.5	22.0	22.0	21.5	21.8	22.0	
CHLORIDE mg/L	00940	9.7	9.3	9.8	9.5	9.5	9.5	9.5	9.5	9.5	9.5	
PHOSPHATE, TOTAL mg/L	00650	0.03	0.05	0.03	0.04	0.05	0.05	0.04	0.04	0.01	0.04	
PHOSPHATE, DISSOLVED mg/L	00666	< 0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	< 0.01	0.01	
CONDUCTIVITY µmhos	00095	285	280	275	280	285	280	280	275	280	270	
RESIDUE NONFILTRABLE mg/L	00530	1	0	1	1	1	3	1	1	1	2	
OXYGEN DEMAND CHEMICAL mg/L	00335	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	
NITROGEN, AMMONIA mg/L	00610	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	
NITROGEN, NITRITE+NITRATE mg/L	00630	0.23	0.23	0.24	0.25	0.26	0.29	0.24	0.24	0.25	0.24	
NITROGEN, ORGANIC mg/L	00605	0.16	0.16	0.16	0.14	0.16	0.16	0.16	0.12	0.16	0.16	
PHENOLIC SUBSTANCES µg/L	32730	< 1		< 1	< 1	-	< 1	-	< 1	-	< 1	
PLATE COUNT 48 hr. 35°C per ml	31755	13	6	2	0	4	20	1	2	1	2	
MF-TC PER 100 ml	31503	4	0	0	0	0	0	0	0	0	0	
MF-FC PER 100 ml	31616	2	0	0	0	0	0	0	0	0	0	
MF-FS PER 100 ml	31679	2	-	0	0	-	0	-	0	-	0	
PLANKTON PER ml	60050	2850	210	3750	8910	7410	5130	1410	930	210	3540	
ACTINOS 14 DAY 20°C PER ml	80148	8	1	0.1	0.3	0.5	0.2	0.3	0.2	0.3	0.4	
FUNGI PER ml	81888	0.3	0.1	0	0.1	0.1	3	0.1	0.1	0	0	

METEOROLOGICAL DATA

									PREVAILING WIND
TIME		0800	0900	1000	1100	1200			00036
DIRECTION	00036	W	W	W	NW	NW			W
VELOCITY	00035	18	10	10	12	16			

SURVEY BY: J.VENCILL/K. RUDMIN

REMARKS: SUNNY-TEMPERATURES IN MID-SEVENTIES
BRISK OFFSHORE WINDS - WAVES 1-3' W/NO SWELLS

CITY OF CHICAGO
WATER PURIFICATION DIVISION

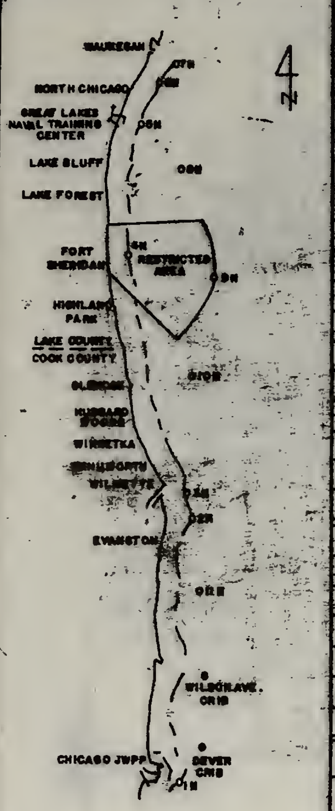
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 35.

NORTH SHORE LAKE SURVEY

DATE AUGUST 15 1984



PARAMETER	STORET NUMBER	1N CHW013	2N CHW011	3N CHW010	5N CHW005	6N CHW004	7N CHW003	8N CHW006	9N CHW008	10N CHW009	11N CHW012
		SAMPLING POINT AND STATION NUMBER									
TIME		0830	0930	0938	1100	1107	1116	1042	1019	1000	0911
TEMPERATURE °C	00010	22	22	22	22	22	22	22	22	22	22
TURBIDITY F.T.U.	00076	1.5	0.80	0.65	0.65	1.0	0.80	0.45	0.30	0.40	0.60
ODOR, THRESHOLD	00086	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M
pH	00400	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
SULFATE mg/L	00945	22.0	22.0	22.0	22.0	22.0	21.5	22.0	22.0	22.0	22.0
CHLORIDE mg/L	00940	9.1	9.1	9.2	9.0	9.5	9.0	9.0	9.0	9.0	9.0
PHOSPHATE, TOTAL mg/L	00650	0.02	0.01	0.01	0.01	0.01	-0.01	0.01	0.01	0.01	0.01
PHOSPHATE, DISSOLVED mg/L	00653	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CONDUCTIVITY μ mhos	90095	285	290	290	290	290	285	290	290	290	295
RESIDUE, NONFILTRABLE mg/L	00530	0	0	0	0	0	1	1	1	2	2
OXYGEN DEMAND, CHEMICAL mg/L	00335	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NITROGEN, AMMONIA mg/L	00610	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	CHECKED 0.10	0.21	0.27	0.26	0.26	0.26	0.27	0.26	0.26	0.25
NITROGEN, ORGANIC mg/L	00605	0.14	0.14	0.14	0.14	0.18	0.14	0.14	0.12	0.14	0.14
PHENOL-LIKE SUBSTANCES μg/L	32730	< 1	-	< 1	< 1	-	< 1	-	< 1	-	< 1
PLATE COUNT 48 hr., 35°C PER mL	31753	52	10	8	3	10	5	2	3	0	11
MF-TC PER 100mL	31503	0	0	0	0	0	0	0	0	0	2
MF-FC PER 100mL	31616	0	0	0	2	0	0	0	0	0	0
MF-FS PER 100mL	31679	0	-	0	0	-	0	-	0	-	2
PLANKTON PER mL	60050	510	390	180	480	240	90	390	330	540	510
ACTINOS 14 DAY, 25°C PER mL	60148	0	0	0	0.1	0	0.1	0	0	0.2	0
FUNGI PER mL	31856	1	0.1	0	0	0	0	1	0	0	1

METEOROLOGICAL DATA

								PREVAILING WIND
TIME		0800	0900	1000	1100	1200	1300	00036
DIRECTION	00036	NW	NW	SW	NW	SE	SE	NW
VELOCITY	00035	7	9	12	7	9	14	

SURVEY BY: J.VENCILL / M. CORTINA

REMARKS: SKIES SUNNY W/NEARSHORE HAZE
TEMPERATURES IN 78-81°F RANGE, 26°C
WAVES 1' WITH NO SWELLS

Table 36.

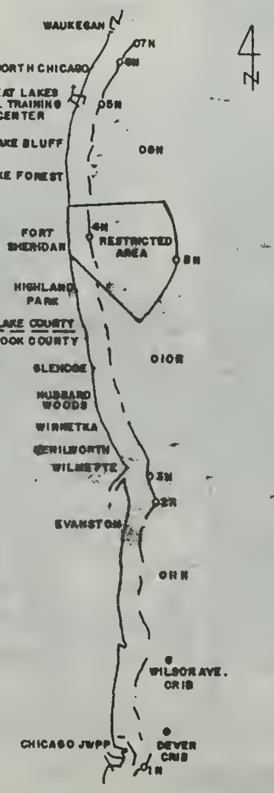
CITY OF CHICAGO
WATER PURIFICATION DIVISION

DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

NORTH SHORE LAKE SURVEY

DATE August 28, 19 84



PARAMETER	STORET NUMBER	1N CHW013	2N CHW011	3N CHW010	5N CHW005	6N CHW004	7N CHW003	8N CHW006	9N CHW008	10N CHW009	11N CHW012	
TIME		0831	0932	0935	1105	1112	1116	1059	1016	0957	0911	
TEMPERATURE °C	00010	21	21	21	21	21	21	21	21	21	21	
TURBIDITY F.T.U.	00076	1.5	1.0	1.0	1.0	1.0	.80	.95	1.0	1.0	1.0	
ODOR, THRESHOLD	00086	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	
pH	00400	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	
SULFATE mg/L	00945	22.0	21.5	22.0	21.5	21.3	21.8	22.0	21.3	22.0	22.3	
CHLORIDE mg/L	00940	8.5	8.5	8.3	8.5	8.5	8.5	8.3	8.4	8.6	8.5	
PHOSPHATE, TOTAL mg/L	00650	0.04	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	
PHOSPHATE, DISSOLVED mg/L	00653	0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	
CONDUCTIVITY μ mhos	00095	285	280	295	290	295	295	295	295	295	295	
RESIDUE, NONFILTRABLE mg/L	00530	3	3	3	2	2	2	3	2	3	3	
OXYGEN DEMAND, CHEMICAL mg/L	00335	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	
NITROGEN, NITRITE-NITRATE mg/L	00630	0.25	0.24	0.24	0.26	0.26	0.27	0.26	0.27	0.26	0.26	
NITROGEN, ORGANIC mg/L	00605	0.14	0.14	0.16	0.14	0.16	0.14	0.14	0.14	0.14	0.11	
PHENOL-LIKE SUBSTANCES μg/L	32730	<1	-	<1	<1	-	<1	-	<1	-	<1	
PLATE COUNT 48 hr., 35 °C PER mL	31753	110	13	8	5	2	3	3	6	7	34	
MF-TC PER 100 mL	31503	0	0	4	0	0	0	0	0	0	4	
MF-FC PER 100 mL	31616	0	0	0	0	0	0	0	0	0	0	
MF-FS PER 100 mL	31679	0	-	0	0	-	0	-	0	-	0	
PLANKTON : PER mL	60050	120	180	60	90	150	720	0	90	150	0	
ACTINOS 14 DAY, 25°C PER mL	80148	0.2	0.2	0	0	1.0	0	0.1	0.1	0	1	
FUNGI PER mL	31856	3.0	0.1	0.1	0.1	0	1	0	0	0	1	

METEOROLOGICAL DATA									PREVAILING WIND
TIME		0800	0900	1000	1100	1200	1300	1400	00036
DIRECTION	00036	SW	SW	SW	SW	SE	SE	SE	SW
VELOCITY	00035	13	11	10	11	11	12	12	

SURVEY BY: J. Vencill/K. Rudmin

REMARKS: Sunny & clear waves 1-2" w/no swells

CITY OF CHICAGO
WATER PURIFICATION DIVISION

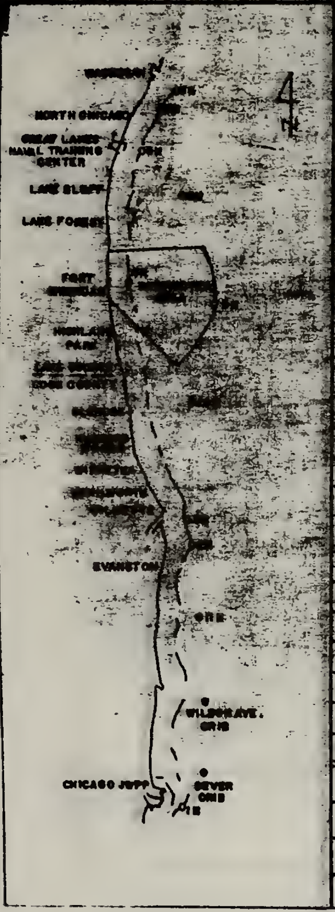
[redacted]
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 37.

NORTH SHORE LAKE SURVEY

DATE October 17, 1984



PARAMETER	STORET NUMBER	SAMPLING POINT AND STATION NUMBER										
		1N CHW013	2N CHW011	3N CHW010	5N CHW005	6N CHW004	7N CHW003	8N CHW006	9N CHW008	10N CHW009	11N CHW012	
TIME		0837	0940	0946	1124	1131	1136	1050	1027	1008	0920	
TEMPERATURE °C	00010	13	9	9	10	10	11	8	10	8	9	
TURBIDITY F.T.U.	00076	1.5	0.75	0.85	1.5	1.5	1.5	0.80	0.55	0.75	0.95	
ODOR THRESHOLD	00086	2DF	1M	1DM	1M	1M	1M	1M	1M	1M	1M	
pH	00400	8.4	8.2	8.3	8.3	8.3	8.3	8.2	8.3	8.2	8.3	
SULFATE mg/L	00945	22.0	21.3	21.5	21.3	21.0	21.0	21.5	21.5	21.5	22.5	
CHLORIDE mg/L	00940	9.5	9.3	9.2	9.1	9.3	9.1	9.1	9.2	9.1	9.2	
PHOSPHATE, TOTAL mg/L	00650	0.03	0.02	0.02	0.02	0.04	0.04	0.04	0.03	0.03	0.04	
PHOSPHATE, DISSOLVED mg/L	00653	0.01	<0.01	0.01	<0.01	<0.01	0.01	0.02	0.01	0.01	0.01	
CONDUCTIVITY µmhos	00095	290	290	290	290	290	295	285	290	290	290	
RESIDUE, NONFILTRABLE mg/L	00530	5	2	2	0	3	4	4	2	1	0	
OXYGEN DEMAND, CHEMICAL mg/L	00335	<5	<5	<5	<5	5.0	5.5	<5	<5	<5	<5	
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
NITROGEN, NITRITE-NITRATE mg/L	00630	0.23	0.28	0.27	0.29	0.28	0.28	0.30	0.27	0.29	0.26	
NITROGEN, ORGANIC mg/L	00605	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.18	0.18	
PHENOL-LIKE SUBSTANCES µg/L	32730	<1	-	<1	<1	-	<1	-	<1	-	<1	
PLATE COUNT 48 hr, 35°C PER mL	31753	120	5	9	160	130	150	4	2	19	5	
MF-TC PER 100mL	31503	34	4	8	40	96	138	0	0	0	22	
MF-FC PER 100mL	31616	12	4	0	12	26	34	0	0	0	2	
MF-FS PER 100mL	31679	4	0	0	0	12	8	0	0	0	0	
PLANKTON PER mL	60050	1470	660	1110	660	1770	1080	390	90	330	2190	
ACTINOS 14 DAY, 25°C PER mL	80148	1.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.2	0.0	
FUNGI PER mL	31856	10.0	8.0	3.0	4.0	7.0	10.0	2.0	6.0	3.0	8.0	

METEOROLOGICAL DATA									PREVAILING WIND
TIME		0800	0900	1000	1100	1200	1300	1400	00036
DIRECTION	00036	NW	NW	NW	NW	NW	E	E	NW
VELOCITY	00035	15	13	13	12	9	8	9	

SURVEY BY: J. VENCILL/A. AGRAWAL

REMARKS: PARTLY CLOUDY W/COOL TEMPERATURES(40's-50's)
WAVES 2' - 4' W/MODERATE SWELLS

CITY OF CHICAGO
WATER PURIFICATION DIVISION

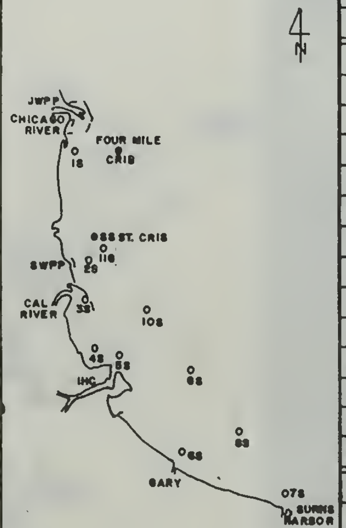
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 38.

SOUTH SHORE LAKE SURVEY

DATE MAY 1, 19 84



PARAMETER	STORET NUMBER	SAMPLING POINT AND STATION NUMBER										
		1S CHW014	2S CHW015	3S CHW017	4S CHW019	5S CHW020	6S CHW021	7S CHW024	8S CHW023	9S CHW022	10S CHW018	11S CHW016
TIME		0923	0954	1006	1031	1040	1115	1145	1206	1229	1254	1316
TEMPERATURE °C	00010	7	7	6	6	7	6	6	7	6	5	6
TURBIDITY F.T.U.	00076	3.9	3.9	4.9	6.1	3.5	3.0	2.2	1.6	4.0	2.0	2.0
ODOR, THRESHOLD	00086	1 DM	2M	1M	2M	2M	2M	1M	2M	1M	2M	1M
pH	00400	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
SULFATE mg/L	00945	23.5	23.5	25.0	25.0	24.0	23.3	22.5	22.5	24.5	23.0	22.5
CHLORIDE mg/L	00940	11.0	10.7	12.5	12.5	10.7	10.1	9.0	8.6	11.5	8.7	8.7
PHOSPHATE, TOTAL mg/L	00650	<0.01	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.02
PHOSPHATE, DISSOLVED mg/L	00653	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CONDUCTIVITY μ mhos	00095	300	300	315	310	295	295	285	285	295	280	275
RESIDUE, NONFILTRABLE mg/L	00530	5	5	8	6	5	5	4	3	4	3	3
OXYGEN DEMAND, CHEMICAL mg/L	00335	7.8	< 5	5.2	5.2	5.5	< 5	< 5	< 5	5.9	< 5	5.5
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	< 0.01	0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.37	0.39	0.44	0.43	0.38	0.37	0.32	0.31	0.40	0.31	0.31
NITROGEN, ORGANIC mg/L	00605	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.14	0.14	0.14	0.14
PHENOL-LIKE SUBSTANCES μg/L	32730	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
PLATE COUNT 48 hr., 35°C PER mL	31753	65	64	210	1200	110	14	0	1	100	3	0
MF-TC PER 100mL	31503	2	20	48	180	108	24	4	6	78	0	2
MF-FC PER 100mL	31616	0	0	6	2	0	0	0	0	0	0	0
MF-PS PER 100mL	31679	0	0	0	0	0	0	0	0	0	0	0
PLANKTON PER mL	60050	6630	6540	6630	7020	8250	6840	3750	5160	3690	4020	4800
ACTINOS 14 DAY, 26°C PER mL	80148	1.1	0.4	0.5	0.1	0.3	1.4	1.9	1.0	0.7	0.4	1.1
FUNGI PER mL	31856	14	10	7	4	9	9	6	4	17	6	5

METEOROLOGICAL DATA									PREVAILING WIND
TIME		0800	0900	1000	1100	1200	1300		00036
DIRECTION	00036	W	NW	NW	NW	NW	W		NW
VELOCITY	00035	13	14	14	16	20	16		

SURVEY BY: J. VENCILL / K. RUDMIN

REMARKS: MOSTLY CLOUDY WITH COOL TEMPERATURES. MODERATE SWELLS WITH WAVE HEIGHTS INCREASING AS THE DAY WORE ON; 3 FT. AND GREATER.

CITY OF CHICAGO
WATER PURIFICATION DIVISION

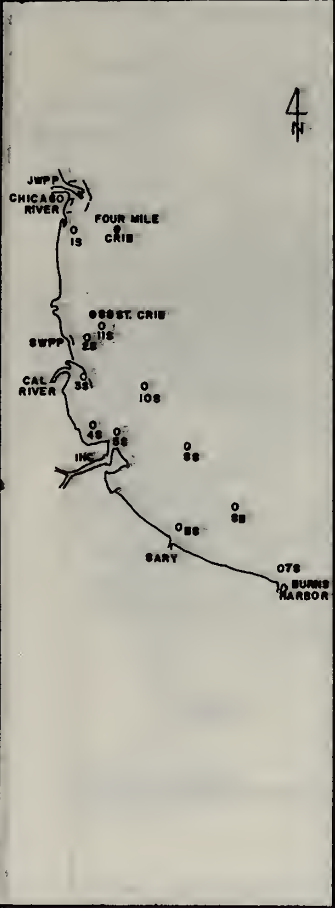
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 39.

SOUTH SHORE LAKE SURVEY

DATE May 22 1984



PARAMETER	STORET NUMBER	SAMPLING POINT AND STATION NUMBER										
		1S	2S	3S	4S	5S	6S	7S	8S	9S	10S	11S
		CHW014	CHW015	CHW017	CHW019	CHW020	CHW021	CHW024	CHW023	CHW022	CHW018	CHW016
TIME		0838	0915	0927	0942	0953	1027	1105	1128	1151	1214	1237
TEMPERATURE °C	00010	11	10	13	11	11	10	11	10	10	11	11
TURBIDITY F.T.U.	00076	0.30	0.80	1.0	0.75	0.85	0.55	0.70	0.45	0.55	0.60	0.65
ODOR THRESHOLD	00086	1M	2DM	1M	1M	1M	1M	1M	1M	2DM	1M	1M
pH	00400	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
SULFATE mg/L	00945	22.5	22.0	23.0	22.0	23.0	22.0	23.0	21.5	22.0	22.0	22.0
CHLORIDE mg/L	00940	9.3	9.1	10.0	9.7	10.2	9.0	10.0	8.8	9.1	9.5	9.2
PHOSPHATE, TOTAL mg/L	00650	0.03	0.03	0.02	0.02	0.02	0.06	0.06	0.04	0.01	0.01	0.01
PHOSPHATE, DISSOLVED mg/L	00653	0.01	0.03	0.01	<0.01	0.01	0.05	0.02	0.01	0.01	0.01	0.01
CONDUCTIVITY µ mhos	00095	285	295	300	295	300	290	285	285	290	290	290
RESIDUE, NONFILTRABLE mg/L	00530	2	1	2	2	1	2	2	1	1	2	2
OXYGEN DEMAND, CHEMICAL mg/L	00335	5.3	6.1	5.7	6.5	6.8	7.2	6.1	<5	6.5	5.7	6.8
NITROGEN, AMMONIA mg/L	00610	0.02	0.02	0.01	0.02	0.01	0.03	0.01	0.01	0.01	0.01	0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.27	0.26	0.28	0.27	0.29	0.27	0.30	0.27	0.27	0.28	0.27
NITROGEN, ORGANIC mg/L	00605	0.18	0.18	0.18	0.18	0.18	0.20	0.20	0.20	0.20	0.20	0.20
PHENOL-LIKE SUBSTANCES µg/L	32730	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PLATE COUNT 48 hr, 35°C PER mL	31753	0	1	0	12	20	0	25	0	0	3	9
MF-TC PER 100mL	31503	0	0	4	32	158	0	152	0	0	0	0
MF-FC PER 100mL	31616	0	0	0	2	22	0	12	0	0	0	0
MF-FS PER 100mL	31679	0	0	0	0	0	0	0	0	0	0	0
PLANKTON PER mL	60050		NO		R E S U L T S							
ACTINOS 14 DAY, 20°C PER mL	80148	1	0	0	0	0	1	1	0	0	0	1
FUNGI PER mL	31856	1	2	2	2	3	2	0	1	0	0	1

METEOROLOGICAL DATA								PREVAILING WIND
TIME		0800	0900	1000	1100	1200	1300	00036
DIRECTION	00036	SW	SW	SW	SW	N	N	
VELOCITY	00035	14	15	13	14	16	15	SW

SURVEY BY: J. VENCILL/M. CORTINA

REMARKS: FAIRLY STRONG WINDS FROM SW
WAVES 2-3' - OVERCAST W/OCCASIONAL RAIN

* NO PLANKTON RESULTS

CITY OF CHICAGO
WATER PURIFICATION DIVISION

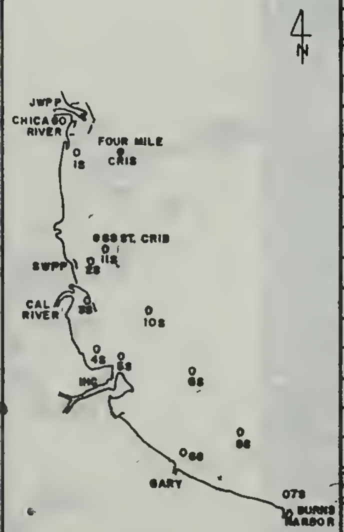
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 4J.

SOUTH SHORE LAKE SURVEY

DATE JUNE 26 19 84



PARAMETER	STORET NUMBER	SAMPLING POINT AND STATION NUMBER										
		1S CHW014	2S CHW015	3S CHW017	4S CHW019	5S CHW020	6S CHW021	7S CHW024	8S CHW023	9S CHW022	10S CHW018	11S CHW016
TIME		0837	0912	0925	0937	0947	1025	1059	1122	1145	1208	1231
TEMPERATURE °C	00010	17	17	18	18	17	17	17	17	17	17	17
TURBIDITY F.T.U.	00076	0.60	0.80	1.0	0.65	0.70	0.50	0.80	0.40	0.45	0.50	0.60
ODOR, THRESHOLD	00086	1 DF	2 DF	1M	1 DF	2M	1M	1M	1M	1M	1M	1M
pH	00400	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
SULFATE mg/L	00945	21.5	21.5	21.8	22.5	22.0	21.8	22.8	21.5	21.5	22.0	21.5
CHLORIDE mg/L	00940	9.0	9.0	9.5	9.7	9.5	9.6	10.0	9.2	9.5	9.5	9.5
PHOSPHATE, TOTAL mg/L	00650	0.03	0.03	0.01	0.01	0.01	0.01	< 0.01	< 0.01	0.01	0.01	0.01
PHOSPHATE, DISSOLVED mg/L	00653	< C.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01
CONDUCTIVITY µ mhos	00095	280	285	290	290	290	290	290	270	280	280	280
RESIDUE, NONFILTRABLE mg/L	00530	1	1	1	1	1	1	1	1	2	1	2
OXYGEN DEMAND, CHEMICAL mg/L	00335	< 5	< 5	5.0	5.4	< 5	< 5	6.1	6.5	6.1	< 5	< 5
NITROGEN, AMMONIA mg/L	00610	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	<0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.24	0.23	0.25	0.24	0.24	0.25	0.29	0.24	0.24	0.23	0.22
NITROGEN, ORGANIC mg/L	00605	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
PHENOL-LIKE SUBSTANCES µg/L	32730	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
PLATE COUNT 48 hr., 35°C PER mL	31753	38	19	61	52	330	72	730	11	21	110	7
MF-TC PER 100mL	31503	0	0	2	0	10	4	300	0	0	2	0
MF-FC PER 100mL	31616	0	0	4	0	0	2	2	0	0	0	0
MF-FS PER 100mL	31679	0	0	0	0	0	0	0	0	0	0	0
PLANKTON PER mL	60050	210	360	540	720	210	420	1110	570	540	60	300
ACTINOS 14 DAY, 26°C PER mL	80148	1	0.1	0.1	0	0	0	2	0	0.1	0	1
FUNGI PER mL	31856	0	0	2	0	0.2	0	8	0	0	0	0

METEOROLOGICAL DATA									PREVAILING WIND
TIME		0800	0900	1000	1100	1200	1300		00036
DIRECTION	00036	SW	SW	SW	SW	SW	SW	.	SW
VELOCITY	00038	13	16	17	17	17	19		

SURVEY BY: A.AGRAWAL/M.CORTINA

REMARKS: PARTLY CLOUDY
WAVES 1-2'

Table 41.

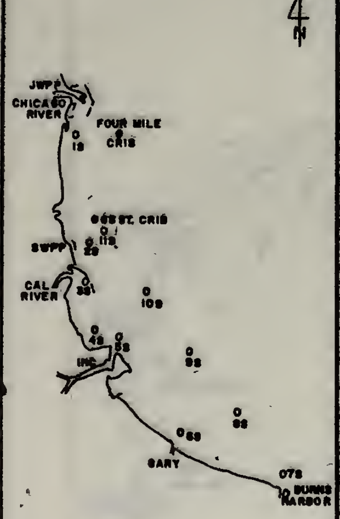
CITY OF CHICAGO
WATER PURIFICATION DIVISION

DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

SOUTH SHORE LAKE SURVEY

DATE August 7, 1984



PARAMETER	STORET NUMBER	1S CHW013	2S CHW015	3S CHW017	4S CHW019	5S CHW020	6S CHW021	7S CHW024	8S CHW023	9S CHW022	10S CHW018	11S CHW016
TIME		0837	0915	0926	0942	0952	1027	1101	1124	1147	1210	1233
TEMPERATURE °C	00010	21	21	20	20	21	21	22	22	22	22	22
TURBIDITY F.T.U.	00076	0.45	0.45	1.0	0.60	1.0	0.40	0.40	0.35	0.35	0.30	0.35
ODOR, THRESHOLD	00086	2DM	1DM	2M	1M	1M	1M	1M	1M	1M	1M	1M
pH	00400	8.7	8.7	8.6	8.6	8.5	8.7	8.7	8.7	8.7	8.7	8.7
SULFATE mg/L	00945	21.0	21.3	20.8	21.3	24.5	21.0	20.3	20.0	20.0	20.0	20.0
CHLORIDE mg/L	00940	9.1	9.5	9.0	9.6	13.0	9.5	9.1	9.0	9.1	10.9	9.0
PHOSPHATE, TOTAL mg/L	00650	0.03	0.02	0.02	0.03	0.05	0.04	0.03	0.02	0.01	0.05	0.01
PHOSPHATE, DISSOLVED mg/L	00653	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.01
CONDUCTIVITY µ mhos	00095	285	290	295	300	325	295	295	300	300	295	290
RESIDUE, NONFILTRABLE mg/L	00530	2	2	1	2	1	0	0	0	0	0	0
OXYGEN DEMAND, CHEMICAL mg/L	00340	<5	<5	<5	<5	6.5	6.8	<5	<5	<5	<5	<5
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.25	0.26	0.23	0.25	0.41	0.26	0.24	0.24	0.25	0.25	0.25
NITROGEN, ORGANIC mg/L	00605	0.16	0.14	0.16	0.16	0.16	0.14	0.16	0.14	0.14	0.16	0.14
PHENOL-LIKE SUBSTANCES µg/L	32730	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PLATE COUNT 48 hr., 35°C PER mL	31753	44	57	40	42	23,000	74	340	10	9	8	7
MF-TC PER 100mL	31503	0	0	4	2	282	20	10	0	0	0	0
MF-FC PER 100mL	31616	0	0	0	0	122	0	0	0	0	0	0
MF-FS PER 100mL	31679	0	0	0	0	0	0	0	0	0	0	0
PLANKTON PER mL	60050	510	390	510	420	930	630	690	390	900	1020	840
ACTINOS 14 DAY, 26°C PER mL	80148	3	1	0	0	0	0	0	0.5	0	0.1	0
FUNGI PER mL	31856	0	0	0	0	0	0	0	1	0	0	0

METEOROLOGICAL DATA										PREVAILING WIND
TIME		0800	0900	1000	1100	1200				00036
DIRECTION	00036	SW	S	NW	W	S				W
VELOCITY	00035	12	12	12	8	9				

SURVEY BY: J. Vencill/K. Rudmin

REMARKS: Cloudy earlier, sun later - waves 2 - 3' w/calm water in the P.M.

CITY OF CHICAGO
WATER PURIFICATION DIVISION

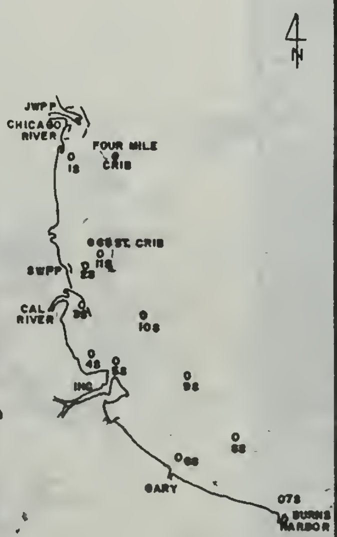
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 42.

SOUTH SHORE LAKE SURVEY

DATE August 21 19 84



PARAMETER	STORET NUMBER	1S CHW014	2S CHW015	3S CHW017	4S CHW019	5S CHW020	6S CHW021	7S CHW024	8S CHW023	9S CHW022	10S CHW018	11S CHW016
TIME		0839	0914	0927	0945	0952	1027	1101	1124	1147	1210	1233
TEMPERATURE °C	00010	21	22	22	22	22	21	21	21	21	21	22
TURBIDITY F.T.U.	00076	1.7	2.1	2.5	2.0	1.6	1.0	1.4	1.0	0.90	0.80	1.2
ODOR, THRESHOLD	00086	2DM	1M	1M	2M	2MM	1M	1MM	1M	1DM	1M	1M
pH	00400	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
SULFATE mg/L	00945	20.5	20.5	21.3	22.0	23.3	20.5	21.3	20.5	20.5	20.5	20.5
CHLORIDE mg/L	00940	8.0	9.5	8.6	9.0	11.0	8.5	8.5	8.0	8.0	8.5	8.0
PHOSPHATE, TOTAL mg/L	00650	0.04	0.03	0.03	0.03	0.04	0.02	0.05	0.03	0.03	0.03	0.04
PHOSPHATE, DISSOLVED mg/L	00653	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
CONDUCTIVITY µ mhos	00095	280	290	290	295	295	285	290	285	285	280	285
RESIDUE, NONFILTRABLE mg/L	00530	2	2	2	1	2	1	1	0	0	0	0
OXYGEN DEMAND, CHEMICAL mg/L	00340	< 5	7.2	6.5	7.2	6.5	7.5	5.4	5.7	5.0	5.4	5.7
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	0.02	<0.01	0.08*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.19	0.23	0.23	0.29	0.31	0.23	0.25	0.22	0.22	0.23	0.23
NITROGEN, ORGANIC mg/L	00605	0.15	0.15	0.16	0.16	0.16	0.16	0.14	0.16	0.12	0.12	0.16
PHENOL-LIKE SUBSTANCES µg/L	32730	<1	<1	<1	<1	<1	<1	<1	<1	<1	< 1	<1
PLATE COUNT 48 hr., 35°C PER mL	31753	15	82	230	660	1100	31	53	9	6	27	23
MF-TC PER 100mL	31503	8	8	12	180	344	0	4	0	0	0	0
MF-FC PER 100mL	31616	0	0	2	2	42	2	4	0	2	0	0
MF-FS PER 100mL	31679	0	0	2	0	0	0	0	0	0	0	0
PLANKTON PER mL	60050	720	780	180	420	690	240	180	1590	1320	30	1890
ACTINOS 14 DAY, 26°C PER mL	80148	0.1	1	2	0	1	0	1	0	0	0	0.1
FUNGI PER mL	31856	0.1	1	2	1	0.1	0.1	0	0	0	0	0

METEOROLOGICAL DATA									PREVAILING WIND
TIME		0800	0900	1000	1100	1200	1300	1400	00036
DIRECTION	00036	SW	SW	SW	SW	SW	SW	SW	SW
VELOCITY	00035	13	14	15	15	16	16	16	

SURVEY BY: VENCILL - RUDMIN

REMARKS: SUNNY W/HAZE
WAVES 1-3'
AIR TEMP. IN THE 70's

*RECHECKED

MH.

CITY OF CHICAGO
WATER PURIFICATION DIVISION

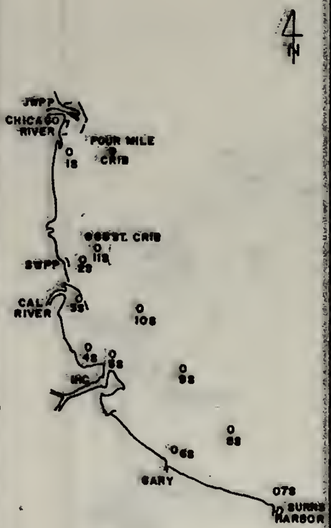
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 43.

SOUTH SHORE LAKE SURVEY

DATE November 21, 1984



PARAMETER	STORET NUMBER	SAMPLING POINT AND STATION NUMBER										
		1S	2S	3S	4S	5S	6S	7S	8S	9S	10S	11S
		CHW014	CHW015	CHW019	CHW017	CHW020	CHW021	CHW024	CHW023	CHW022	CHW018	CHW016
TIME		0842	0916	0928	0943	0953	1028	1103	1126	1149	1212	1235
TEMPERATURE °C	00010	4	4	4	4	4	5	5	5	5	5	4
TURBIDITY F.T.U.	00076	10.0	9.6	9.4	11.0	8.4	6.6	5.4	3.7	2.9	3.1	3.7
ODOR, THRESHOLD	00086	1M	1M	1M	2M	1M	1M	1M	1M	1M	1M	1M
pH	00400	8.2	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
SULFATE mg/L	00945	22.2	22.0	23.4	23.7	22.3	22.7	23.1	22.3	22.2	22.2	22.4
CHLORIDE mg/L	00940	9.1	9.4	10.0	10.0	9.4	9.5	9.9	9.5	9.9	9.4	9.5
PHOSPHATE, TOTAL mg/L	00650	0.05	0.05	0.03	0.05	0.02	0.03	0.03	0.02	0.02	0.02	0.02
PHOSPHATE, DISSOLVED mg/L	00653	0.02	<0.01	<0.01	0.01	<0.01	0.02	0.02	0.02	0.02	0.02	0.02
CONDUCTIVITY µ mhos	00095	285	275	275	290	280	270	265	250	260	255	265
RESIDUE, NONFILTRABLE mg/L	00530	18	15	8	18	14	10	10	6	6	6	6
OXYGEN DEMAND, CHEMICAL mg/L	00335	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
NITROGEN, AMMONIA mg/L	00610	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.27	0.27	0.26	0.28	0.24	0.24	0.27	0.26	0.26	0.27	0.27
NITROGEN, ORGANIC mg/L	00605	0.15	0.15	0.16	0.14	0.15	0.15	0.15	0.16	0.15	0.16	0.16
PHENOL-LIKE SUBSTANCES µg/L	32730	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PLATE COUNT 48 hr., 35°C PER mL	31753	55	83	73	96	50	82	95	5	8	9	21
MF-TC PER 100mL	31503	0	12	0	112	4	12	12	4	0	4	4
MF-FC PER 100mL	31616	4	4	2	98	5	0	2	0	0	0	0
MF-FS PER 100mL	31679	0	0	2	22	2	2	0	0	0	0	0
PLANKTON PER mL	60050	430	480	1350	870	570	2070	1890	1710	1470	2430	1440
ACTINOS 14 DAY, 26°C PER mL	80148	1.2	1.0	5.0	4.0	2.0	1.0	0.3	0.0	0.2	0.2	0.1
FUNGI PER mL	31856	1.0	3.0	3.0	4.0	1.0	2.0	1.0	2.0	0.1	1.0	1.0

METEOROLOGICAL DATA									PREVAILING WIND
TIME		0800	0900	1000	1100	1200	1300	1400	00036
DIRECTION	00036	NW	NW	NW	NW	S	S	SW	
VELOCITY	00038	9	9	11	9	10	10	12	NW

SURVEY BY: J. VENCILL/K. RUDMIN

REMARKS: OVERCAST W/MODERATE TO HEAVY SWELLS, WAVES 2-5′

CITY OF CHICAGO
WATER PURIFICATION DIVISION

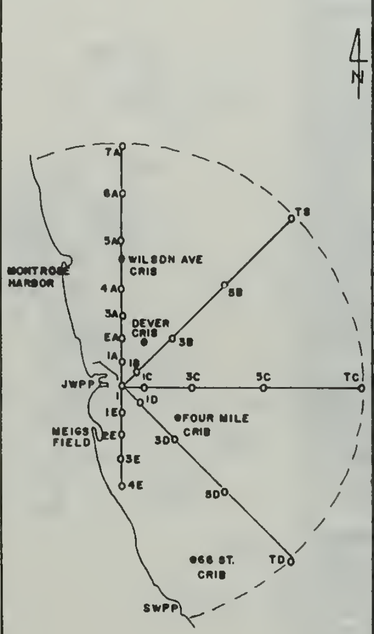
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 44.

J.W.P.P. RADIAL LAKE SURVEY

DATE MAY 30, 19 84



PARAMETER	STORET NUMBER	1A	EA	3A	4A	5A	6A	7A	1B	3B	5B	7B	1C	3C	5C	7C	1D	3D	5D	7D	1E	2E	3E	4E
		CHW082	CHW047	CHW042	CHW037	CHW033	CHW029	CNW025	CNW083	CNW045	CHW034	CHW026	CHW054	CWH044	CHW036	CHW027	CHW058	CHW045	CHW038	CHW028	CHW066	CHW051	CHW046	CHW041
TIME		0829	0833	0838	0842	0851	0900	0909	1037	1028	1004	0946	1043	1052	1106	1124	1241	1232	1218	1200	1350	1255	1259	1304
TEMPERATURE °C	00010	10	10	9	9	9	9	8	10	8	8	8	10	8	8	8	10	9	9	9	10	10	10	11
TURBIDITY F.T.U.	00076	2.0	1.5	1.6	1.5	1.6	1.0	1.0	2.5	.90	.85	.75	3.0	.85	.80	.65	3.5	1.1	.85	.75	3.6	4.0	2.8	2.4
ODOR, THRESHOLD	00086	2 DM	1M	1M	1M	1 DM	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M
pH	00400	8.0	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
SULFATE mg/L	00945	21.5	21.0	21.0	21.5	21.5	21.0	21.5	21.0	21.0	21.8	21.0	21.0	21.0	21.0	21.0	21.5	21.3	21.3	21.5	21.5	21.5	22.0	21.5
CHLORIDE mg/L	00940	9.0	9.5	9.6	9.0	9.0	9.4	9.4	9.1	9.0	8.9	9.0	9.0	9.2	9.2	9.0	9.0	8.7	9.1	9.0	9.0	9.5	9.5	8.5
PHOSPHATE, TOTAL mg/L	00650	.02	.01	.02	.02	.02	.01	.01	.02	.02	.03	.02	.02	.02	.02	.03	.03	.02	.02	.03	.03	.02	.02	.02
PHOSPHATE, DISSOLVED mg/L	00653	.01	.01	<.01	<.01	.02	.01	<.01	.01	.01	.01	.01	.01	.01	.02	.02	.02	.01	.02	.01	.03	.01	.02	.02
CONDUCTIVITY μ mhos	00095	270	290	280	285	290	290	290	290	285	285	275	285	285	285	285	290	285	285	280	290	280	290	290
RESIDUE, NONFILTRABLE mg/L	00530	1	8	4	5	6	4	4	6	5	3	3	6	3	4	4	7	4	4	4	7	7	7	5
OXYGEN DEMAND, CHEMICAL mg/L	00335	< 5	< 5	<5	<5	<5	<5	<5	<5	<5	<5	<5	< 5	< 5	< 5	5.1	<5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NITROGEN, AMMONIA mg/L	00610	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
NITROGEN, NITRITE-NITRATE mg/L	00630	.27	.27	.27	.26	.27	.26	.27	.26	.27	.27	.27	.27	.27	.27	.28	.27	.27	.27	.26	.27	.27	.27	.27
NITROGEN ORGANIC mg/L	00605	.16	.16	.16	.16	.16	.16	.12	.16	.20	.12	.16	.12	.20	.16	.12	.16	.20	.16	.22	.16	.20	.16	.22
IRON, TOTAL μg/L	01045	25	15	<10	<10	10	<10	< 10	30	10	10	<10	20	<10	<10	15	<10	<10	10	10	30	40	100	100
PHENOL-LIKE SUBSTANCES μg/L	32730	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLATE COUNT 48hr., 35°C PER mL	31753	2	3	0	3	1	0	1	3	2	1	1	19	0	0	1	5	0	0	0	1	13	2	1
MF-TC PER 100 mL	31503	8	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	2	2	2
MF-FC PER 100 mL	31616	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	2	2	2	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLANKTON PER mL	60050	3120	-	3990	-	8790	-	7680	-	3360	5490	3630	8580	8040	5850	4590	7680	9990	8130	8490	8550	-	4350	-
ACTINOS 14 DAY, 25°C PER mL	80148	0.8	0.5	0.3	0.3	1.1	0.4	0.1	0.1	0.1	0.4	0.2	0.5	0.3	0.2	0.7	0.1	0.4	0	0.4	0.4	0	0.2	0
FUNGI PER mL	31856	3	2	3	3	1	3	1	1	1	1	3	1	1	0	2	2	0	0	1	2	1	3	1

METEOROLOGICAL DATA									PREVAILING WINDS
TIME		0800	0900	1000	1100	1200	1300	1400	00036
DIRECTION	00036	W	W	NW	NW	NW	NW	N	NW
VELOCITY	00035	15	13	15	21	20	9	8	

SURVEY BY M. OSMAN / K. RUDMIN

REMARKS: SUNNY, 2-3' SWELLS
N-W WINDS

Table 45.

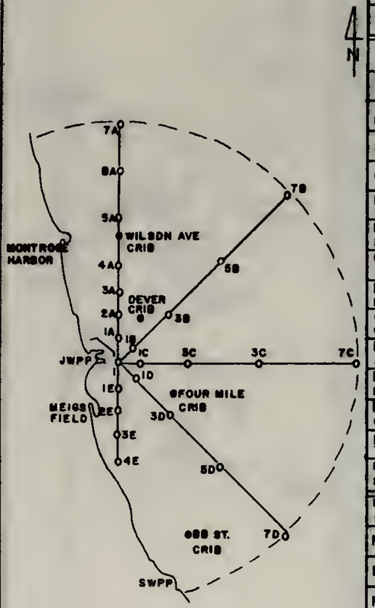
CITY OF CHICAGO
WATER PURIFICATION DIVISION

DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

J.W.P.P. RADIAL LAKE SURVEY

DATE July 31, 1984



PARAMETER	STORET NUMBER	SAMPLING POINT AND STATION NUMBER																						
		1A	2A	3A	4A	5A	6A	7A	1B	3B	5B	7B	1C	3C	5C	7C	1D	3D	5D	7D	1E	2E	3E	4E
		CHW052	CHW047	CHW042	CHW037	CHW033	CHW029	CHW025	CHW053	CHW043	CHW034	CHW026	CHW054	CHW044	CHW035	CHW027	CHW055	CHW045	CHW036	CHW028	CHW056	CHW051	CHW046	CHW041
TIME		0634	0839	0843	0848	0857	0906	0915	1031	1022	1008	0950	1047	1056	1110	1128	1244	1235	1221	1203	1304	1309	1313	1318
TEMPERATURE °C	00010	21	21	21	20	20	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
TURBIDITY F.T.U.	00076	1.0	1.0	0.50	0.50	0.50	0.30	0.30	0.75	0.30	0.20	0.65	0.20	0.30	0.30	0.25	0.70	0.25	0.50	0.30	1.0	1.0	1.0	1.0
ODOR, THRESHOLD	00086	2DM	2DM	2M	1M	1M	1M	1M	1M	1DM	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M
pH	00400	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.5	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
SULFATE mg/L	00945	21.3	21.3	21.5	21.3	21.3	21.5	21.3	21.3	21.5	21.5	21.0	21.5	21.3	21.0	21.5	21.3	21.5	21.5	21.5	21.3	21.5	21.3	21.0
CHLORIDE mg/L	00940	11.5	11.5	12.0	11.5	11.6	11.5	11.5	11.4	11.3	11.5	11.1	11.3	8.7	8.6	8.1	8.1	8.1	8.2	8.1	10.6	10.5	8.0	11.6
PHOSPHATE, TOTAL mg/L	00650	0.07	0.05	0.04	0.08	0.04	0.05	0.05	0.04	0.04	0.05	0.05	0.03	0.03	0.04	0.04	0.06	0.03	0.02	0.03	0.04	0.03	0.05	0.05
PHOSPHATE, DISSOLVED mg/L	00653	0.04	0.04	0.02	0.02	0.01	0.04	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.04	0.03	0.04	0.01	0.01	0.01	0.04	0.03	0.04	0.03
CONDUCTIVITY µ mhos	00095	285	285	285	285	285	285	285	285	280	280	280	285	285	285	285	280	280	280	290	290	290	290	290
RESIDUE, NONFILTRABLE mg/L	00530	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	1	1	2	2
OXYGEN DEMAND, CHEMICAL mg/L	00335	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
NITROGEN, AMMONIA mg/L	00610	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.05	0.19	0.26	0.26	0.27	0.22	0.27	0.26	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.28	0.27	0.27	0.03	0.26	0.26	0.27
NITROGEN ORGANIC mg/L	00605	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.12	0.14	0.14	0.14	0.14	0.14	0.14	0.18	0.14	0.14	0.14	0.18	0.12	0.14	0.14
IRON, TOTAL µg/L	01045	20	20	10	15	25	20	15	15	15	15	20	35	15	25	15	10	25	10	20	15	15	20	55
PHENOL-LIKE SUBSTANCES µg/L	32730	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLATE COUNT 48hr., 35°C PER mL	31753	25	15	10	6	4	1	3	18	0	0	1	1	0	1	1	5	1	0	0	0	2	0	2
MF-TC PER 100 mL	31503	2	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FC PER 100 mL	31616	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLANKTON PER mL	60050	210	-	210	-	120	-	180	60	180	360	180	330	180	240	360	240	250	270	330	120	-	300	-
ACTINOS 14 DAY, 26°C PER mL	80148	0.1	0.1	1	0.	0.1	0	0	0.3	0	0.2	0.1	0.1	0.1	0	0	0	0	0	0.1	0	0	0	0
FUNGI PER mL	31856	1	0.1	0.1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0

METEOROLOGICAL DATA									PREVAILING WINDS
TIME		0800	0900	1000	1100	1200	1300	1400	00036
DIRECTION	00036	S	S	SE	S	S	SE	SE	S
VELOCITY	00035	11	9	3	15	9	11	14	

SURVEY BY: J. Vencill/M. Cortina

REMARKS:

Clear & sunny w/temp in 80's waves 2'/no swells

CITY OF CHICAGO
WATER PURIFICATION DIVISION

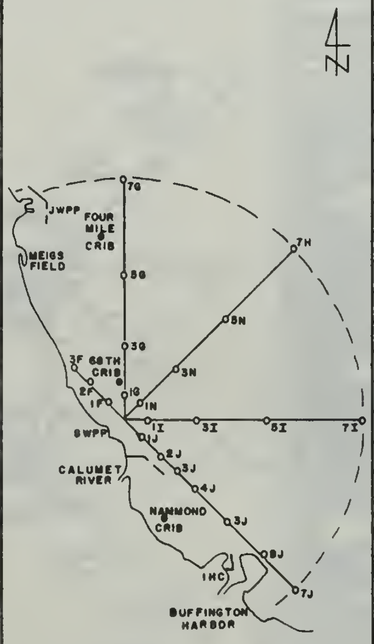
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 4b.

S W P.P. RADIAL LAKE SURVEY

DATE May 16, 19 84



PARAMETER	STORET NUMBER	SAMPLING POINT AND STATION NUMBER																					
		1F	2F	3F	1G	3G	5G	7G	1H	3H	5H	7H	1I	3I	5I	7I	1J	2J	3J	4J	5J	6J	7J
		CHW083	CHW078	CHW073	CHW084	CHW074	CHW065	CHW057	CHW085	CHW075	CHW086	CHW069	CHW066	CHW076	CHW067	CHW059	CHW087	CHW082	CHW077	CHW072	CHW068	CHW064	CHW060
TIME		1212	1217	1221	1002	0953	0939	0921	1242	1251	1305	1323	1016	1025	1039	1057	1204	1200	1155	1151	1142	1133	1124
TEMPERATURE °C	00010	10	9	10	9	8	7	7	10	9	7	6	9	8	8	6	10	10	10	10	9	9	8
TURBIDITY F.T.U.	00076	1.5	1.6	1.7	1.5	1.3	1.0	1.0	1.5	1.4	1.0	0.85	1.5	1.7	1 5	0.80	1.5	1.8	1.7	1.6	1.4	1.1	0.8
ODOR, THRESHOLD	00086	1DM	1DM	1M	1M	1M	1M	1M	1DF	1DM	1M	1M	1DM	2DF	1M	1M	1M	1M	2DF	1DF	1M	1M	1M
pH	00400	8.2	8.4	8.4	8.3	8.4	8.2	8.4	8.5	8.5	8.4	8.4	8.5	8.5	8.5	8.4	8.5	8.5	8.5	8.5	8.5	8.4	8.5
SULFATE mg/L	00945	22.7	23.5	23.5	23.0	23.5	24.0	23.0	23.5	23.0	22.5	23.0	23.5	23.0	23.0	22.5	23.5	23.5	23.5	23.0	23.5	23.3	22.5
CHLORIDE mg/L	00940	10.4	9.7	9.7	9.7	9.5	9.0	9.2	9.6	9.6	9.0	8.9	9.7	9.6	9.4	8.9	10.1	10.1	10.0	10.0	9.9	9.4	10.7
PHOSPHATE, TOTAL mg/L	00650	<0.01	<0.01	0.01	<0.01	0.01	0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.01	0.02
PHOSPHATE, DISSOLVED mg/L	00653	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
CONDUCTIVITY µ mhos	00095	295	295	295	295	295	290	290	295	295	290	290	290	290	280	290	295	295	295	290	285	285	275
RESIDUE, NONFILTRABLE mg/L	00530	7	7	7	7	7	7	6	7	7	7	7	8	7	7	5	7	6	7	7	7	5	5
OXYGEN DEMAND, CHEMICAL mg/L	00335	8.4	< 5	5.7	5.7	5.3	< 5	< 5	< 5	< 5	<5	<5	<5	< 5	<5	<5	<5	< 5	6.5	6.1	5.3	< 5	< 5
NITROGEN, AMMONIA mg/L	00610	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.11	0.13	0.20	0.25	0.20	0.04	<0.04	0.20	0.27	0.28	0.19	0.28	0.29	0.30	0.26	0.09	0.30	<.04	0.22	0.27	0.24	0.29
NITROGEN, ORGANIC mg/L	00605	0.17	0.20	0.16	0.18	0.16	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.18	0.16	0.14	0.20	0.16	0.18	0.15	0.16	0.16	0.16
IRON, TOTAL µg/L	01045	<10	<10	<10	10	<10	10	15	10	10	10	10	10	15	20	10	15	10	10	10	10	15	10
PHENOL-LIKE SUBSTANCES µg/L	32730	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 1	< 1	<1	< 1	<1	<1	<1
PLATE COUNT 48hr., 35°C PER mL	31753	1	0	1	2	2	0	0	2	2	1	0	1	0	0	6	3	6	3	0	0	0	0
MF-TC PER 100 mL	31503	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FC PER 100 mL	31616	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0
PLANKTON PER mL	60050	7230	-	7020	2280	3600	3630	2340	4920	3870	3420	1710	2910	2280	2520	1320	3840	-	2340	-	2820	- -	1950
ACTINOS 14 DAY, 26°C PER mL	80148	0	1.1	0.6	0.6	0.2	1	1	0.2	0.2	0.3	0.1	0.1	0.2	0.4	0.5	0.3	0.3	0.2	0.1	0.2	0.3	0
FUNGI PER mL	31856	4	2	4	3	1	2	0	4	1	1	0	4	2	1	2	7	2	2	2	1	1	1

METEOROLOGICAL DATA									PREVAILING WINDS
TIME		0800	0900	1000	1100	1200	1300	1400	00036
DIRECTION	00036	N	N	NE	E	E	E	NE	NE
VELOCITY	00035	7	7	9	10	8	10	7	

SURVEY BY: J. VENCILL/ K. RUDMIN

REMARKS: COOL AND SUNNY - SMALL SWELLS
WAVE 1-2'

NOTE LOW LEVELS IN
NITROGEN-NITRITE/NITRATE

Table 47.

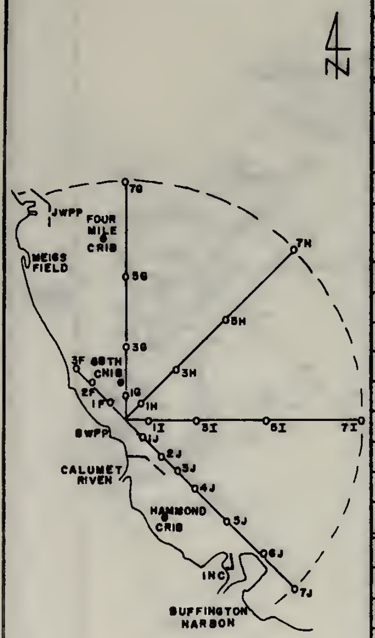
CITY OF CHICAGO
WATER PURIFICATION DIVISION

DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

S.W.P.P. RADIAL LAKE SURVEY

DATE July 10, 1984



PARAMETER	STORET NUMBER	1F	2F	3F	1G	3G	5G	7G	1H	3H	5H	7H	1I	3I	5I	7I	1J	2J	3J	4J	5J	6J	7J
		[illegible]	[illegible]	CHW073	CHW064	CHW074	CHW065	CHW057	[illegible]	CHW078	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	CHW067	CHW062	CHW077	CHW072	[illegible]	[illegible]	CHW060
TIME		1138	1123	1146	0925	0916	0902	0844	1205	1214	1228	1246	0940	0949	1003	1021	1127	1123	1118	1114	1105	1056	1047
TEMPERATURE °C	00010	18	18	18	18	18	18	17	18	18	18	18	18	18	17	18	18	18	18	18	18	18	18
TURBIDITY F.T.U.	00076	0.70	0.75	0.70	060	0.50	0.50	0.45	0.60	0.40	0.40	0.30	0.60	0.40	0.50	0.30	0.75	0.70	0.60	0.50	0.45	0.55	0.55
ODOR, THRESHOLD	00086	1M	1M	1M	2DF	2M	2M	2M	2M	2M	1M	1M	1DM	1M	1M	1M	2DF	2M	1M	1M	1DM	1M	1M
pH	00400	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
SULFATE mg/L	00945	21.3	21.5	21.5	21.5	21.8	22.0	21 8	21.5	21.5	21.8	22.0	22.0	22.0	22.0	22.0	21.5	22.0	22.0	22.0	22.3	22.3	22.0
CHLORIDE mg/L	00940	8.0	8.0	8.0	8.5	9.5	9.0	8.0	8.0	9.0	8.0	7.5	8.5	9.0	8.0	8.0	8.5	8.0	8.0	9.0	9.0	9.0	9.0
PHOSPHATE, TOTAL mg/L	00650	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.03	0.01	0.04	0.03	0.01	0.02	0.03	0.01	0.03	0.05	0.02	0.02	0.01	0.01	0.02
PHOSPHATE, DISSOLVED mg/L	00653	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CONDUCTIVITY μ mhos	00095	230	280	275	280	230	275	270	275	275	280	275	275	270	270	270	270	275	280	275	275	280	275
RESIDUE, NONFILTRABLE mg/L	00530	3	3	3	3	2	2	3	3	2	2	2	3	2	2	1	2	2	2	1	2	2	2
OXYGEN DEMAND, CHEMICAL mg/L	00335	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5.3	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
NITROGEN, AMMONIA mg/L	00610	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	0.01	0.01	<.01	<.01	<.01	0.01	0.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.19	0.24	0.24	0.25	0.25	0.25	0.26	0.25	0.26	0.27	0.17	0.26	0.26	0.27	0.26	0.24	0.25	0.26	0.26	0.26	0.26	0.27
NITROGEN, ORGANIC mg/L	00605	0.19	0.23	0.13	0.13	0.23	0.23	0.13	0.13	0.19	0.19	0.19	0.23	0.19	0.19	0.23	0.15	0.13	0.19	0.19	0.13	0.19	0.19
IRON, TOTAL μg/L	01045	43	38	47	41	35	32	53	44	34	40	28	44	38	40	26	47	73	52	44	60	39	37
PHENOL-LIKE SUBSTANCES μg/L	32730	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	<1	<1	<1	<1	<1
PLATE COUNT 48hr., 35°C PER mL	31753	7	16	16	24	16	16	15	11	8	4	6	8	10	81	4	15	9	8	9	9	63	130
MF-TC PER 100 mL	31503	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	4
MF-FC PER 100 mL	31616	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0
PLANKTON PER mL	60050	270	-	840	390	2400	150	1170	690	120	1140	540	210	1320	0	0	7530	-	780	-	5160	-	1860
ACTINOS 14 DAY, 26°C PER mL	80148	0	0.1	0	0	0	0	0	0	0.1	0	0	0	1	0	0	0	0.1	0	1	0	0	0
FUNGI PER mL	31856	0.1	0	0	0	0	1	1	0.1	1	0	0	0.1	0	1	1	0.1	0	0	1	0	0	0

METEOROLOGICAL DATA

									PREVAILING WINDS 00036
TIME		0800	0900	1000	1100	1200	1300	1400	
DIRECTION	00036	W	SW	W	W	NE	E	SE	
VELOCITY	00035	11	11	13	16	6	8	9	W

SURVEY BY: J. Vencill/K.Rudmin

REMARKS: Skies clear south and overcast to the north wave 2' w/no swells.

CITY OF CHICAGO
WATER PURIFICATION DIVISION

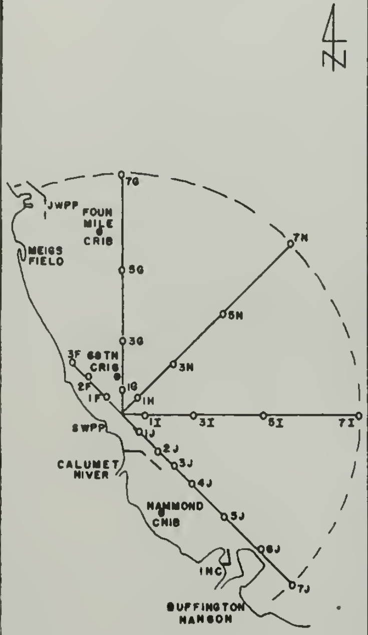
DEPARTMENT OF WATER
WATER QUALITY SURVEILLANCE SECTION

BUREAU OF WATER OPERATIONS
WATER PURIFICATION LABORATORY

TABLE 48.

S.W.P.P. RADIAL LAKE SURVEY

DATE OCTOBER 2, 1984



PARAMETER	STORET NUMBER	1F	2F	3F	1G	3G	5G	7G	1N	3N	5N	7N	1I	3I	5I	7I	1J	2J	3J	4J	5J	6J	7J
		CHW063	[illegible]	CHW073	CHW064	CHW074	CHW065	CHW057	[illegible]	CHW078	CHW066	CHW058	CHW066	CHW079	CHW067	CHW059	CHW067	CHW062	CHW077	CHW072	CHW068	CHW064	CHW060
TIME		1144	1149	1153	0930	0921	0907	0849	1211	1220	1234	1252	0945	0954	1008	1026	1132	1128	1123	1119	1110	1101	1052
TEMPERATURE °C	00010	13	13	13	13	13	14	14	13	13	15	15	13	13	14	14	13	13	14	14	14	14	14
TURBIDITY F.T.U.	00076	1.3	0.75	1.0	0.70	0.70	0.75	0.65	0.75	0.60	0.70	0.45	0.85	0.60	0.60	0.50	0.80	1.0	0.65	0.75	0.75	0.70	0.70
ODOR, THRESHOLD	00086	1M	1M	1M	1M	1M	1M	1M	1M	1 DM	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M
pH	00400	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
SULFATE mg/L	00945	22.0	22.0	22.5	22.0	22.0	22.0	22.0	22.0	22.0	21.8	22.0	22.0	22.0	22.5	22.0	23.0	22.5	22.0	22.0	22.3	22.5	22.0
CHLORIDE mg/L	00940	9.2	9.0	10.0	9.0	8.8	9.2	9.0	9.1	9.0	8.7	8.6	9.1	9.0	9.0	9.1	9.1	9.5	9.1	9.0	9.0	9.0	9.0
PHOSPHATE, TOTAL mg/L	00650	0.05	0.08	0.08	0.08	0.05	0.05	0.05	0.06	0.06	0.06	0.05	0.06	0.04	0.02	0.05	0.03	0.03	0.05	0.01	0.02	0.01	0.01
PHOSPHATE, DISSOLVED mg/L	00653	0.04	0.04	0.06	0.06	0.04	0.04	0.04	0.06	0.05	0.06	0.05	0.05	0.04	0.01	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01
CONDUCTIVITY µ mhos	00095	285	280	285	285	285	290	285	290	280	280	280	285	280	285	280	280	285	280	270	285	285	280
RESIDUE, NONFILTRABLE mg/L	00530	3	2	2	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1
OXYGEN DEMAND, CHEMICAL mg/L	00335	< 5	< 5	< 5	< 5	< 5	< 5	<5	<5	<5	<5	<5	<5	<5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
NITROGEN, AMMONIA mg/L	00610	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01	< .01
NITROGEN, NITRITE-NITRATE mg/L	00630	0.12	0.21	0.23	0.22	0.22	0.23	0.22	0.23	0.21	0.19	0.19	0.23	0.22	0.21	0.30	0.16	0.23	0.22	0.22	0.21	0.19	0.22
NITROGEN, ORGANIC mg/L	00605	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.14	0.12	0.14	0.12	0.12	0.12	0.12	0.14	0.14	0.12	0.14	0.12	0.14
IRON, TOTAL µg/L	01045	10	< 10	< 10	10	<10	10	20	20	25	15	< 10	20	20	15	< 10	20	10	10	10	20	< 10	< 10
PHENOL-LIKE SUBSTANCES µg/L	32730																						
PLATE COUNT 48hr., 35°C PER mL	31753	5	1	1	1	9	0	8	2	2	1	5	4	0	1	2	4	2	0	1	2	6	4
MF-TC PER 100 mL	31503	20	4	2	4	0	0	2	4	4	0	0	6	2	0	0	0	0	0	0	0	2	2
MF-FC PER 100 mL	31616	24	2	0	0	0	0	0	0	2	0	0	0	0	0	0	6	0	0	0	2	0	0
MF-FS PER 100 mL	31679	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0
PLANKTON PER mL	60050	720	-	390	270	2100	1110	180	1170	180	90	60	1860	840	90	420	1290	-	4260	-	90	-	630
ACTINOS 14 DAY, 28°C PER mL	80148	0.7	0.5	1	0.8	0.5	0.9	0.4	0.3	0.4	0.4	0.4	0.3	0.5	0.3	0.8	0.3	0.5	0.4	0.5	0.5	1	0.8
FUNGI PER mL	31856	8	3	3	0	0	5	2	0	2	0	2	1	0	3	0	0	0	0	1	1	3	3

METEOROLOGICAL DATA									PREVAILING WINDS
TIME		0800	0900	1000	1100	1200	1300	1400	00036
DIRECTION	00036	SW	SW	SW	SW	SW	W	SW	SW
VELOCITY	00035	12	12	13	15	20	18	17	

SURVEY BY: J. VENCILL/M. CORTINA

REMARKS: SUNNY AND CLEAR WAVES 3-4' WITH INCREASING SWELLS - GUSTING WINDS.

APPENDIX II

GLOSSARY

Actinomycetes

A group of organisms related to both fungi and bacteria with the capacity to produce quantities of odoriferous substances. Identification of their relative abundance in a drinking water source provides a parameter in the assessment of water quality. Organic substances such as phenol, cellulose and dead plant cells will provide sufficient carbon and nitrogen to stimulate actinomycetes population growth.

*Aldrin

Aldrin is an organochlorine compound primarily used as an insecticide. A fumigant, contact, and stomach pesticide, aldrin is most dangerous when absorbed through the skin. Aldrin is no longer manufactured in the United States. The standard for aldrin in public water supply waters is 1.0 ug/L (Illinois Pollution Control Board, 1977).

Barium

Barium is an alkaline earth metal which occurs in nature chiefly as the insoluble salts barite and witherite. Many of the barium salts are soluble in water, but they are thought to be rapidly precipitated or removed from solution by absorption and sedimentation. Barium compounds are used in the manufacture of paints, glass, paper, explosives, lubricating oils, and synthetic rubber, as well as for printing and dyeing fabrics and for medicinal purposes. Barium concentrations in surface waters can be as high as 340 ug/L (McNeely et al., 1979). Concentrations greater than 5000 ug/L are harmful to many fish species (McNeely, et al., 1979). The state drinking water standard for finished water is 1.0 mg/L.

*Beryllium

Beryllium is a relatively rare element that does not usually occur in natural waters. Although beryllium chloride and nitrate are highly soluble in water, and beryllium sulfate is moderately soluble, beryllium carbonate and hydroxide are almost insoluble in cold water of alkaline pH. Beryllium is used primarily in metallurgy to produce special alloys, in the manufacture of X-ray diffraction tubes and electrodes for neon signs, and in nuclear reactors. Beryllium is usually present in concentrations less than 1.0 ug/L (McNeely et al., 1979). The USEPA (1976) recommended a standard of 11 ug/L beryllium for the protection of aquatic life in soft freshwater and 1,100 ug/L in hard freshwater.

Boron

Boron is never found in nature in its elemental form; it is usually found as a sodium or calcium borate salt. Elemental boron can be used in nuclear reactors as a neutron absorber. Boric acids and boron salts are used for weatherproofing wood, fireproofing fabrics, the manufacture of glass, porcelain, leather, carpets, cosmetics, photographic materials and other purposes. Boric acid is also used as a fungicide, a bactericide, and as a component in several pesticides. The average concentration of boron in surface waters is usually near 100 ug/L. However, concentrations up to 4000 ug/L have been found in the winter when groundwater, which may contain greater amounts, constitutes a larger portion of the total discharge (McNeely et al., 1979).

*Cadmium

Cadmium is relatively rare in water and occurs in nature chiefly as a sulfide salt most frequently found in association with zinc and lead.

Anthropogenic inputs can be significant. Cadmium salts occur in wastes from manufacture of pigments, electroplating plants, and chemical and textile industries. The combustion of fossil fuels releases cadmium to the atmosphere which eventually enters the hydrologic cycle through precipitation. Cadmium can accumulate in soils in the area of mines and smelters resulting in locally high concentrations in water. Cadmium is a non-essential biological element which is cumulative and highly toxic to most organisms including man. Increased hardness and/or alkalinity have been shown to decrease cadmium toxicity (USEPA, 1976; McNeely et al., 1979). As a result of the cumulative toxic effect of cadmium, the Illinois Pollution Control Board (1977) has stipulated the waters of the State shall not exceed a concentration of 50 ug/L and water used for food processing and public consumption shall not exceed a concentration of 10 ug/L.

*Chlordane

Chlordane is an organochlorine compound primarily used as an termiticide. It is both a stomach and contact insecticide. The standard for chlordane in public water supplies is 3.0 ug/L (Illinois Pollution Control Board, 1977).

Chloride

Chlorides are one of the most common naturally occurring chemical constituents of surface waters. Sanitary wastes and certain industrial discharges and use of salt for snowmelt purposes may contribute significant amounts of chloride to receiving waters. At higher concentrations, chloride will cause a slight decrease in the solubility of oxygen in water and can harm metallic equipment and plant life. The standard for chloride in Lake Michigan is 12.0 mg/L (Illinois Pollution Control Board, 1977).

Chlorophyll

Chlorophyll _a_ is the major photosynthetic pigment contained in plants. Extraction and quantification of this pigment can be used to estimate the amount (biomass, standing crop) of planktonic algae present in a body of water. Lakes with chlorophyll _a_ concentrations less than 4 ug/L are classified as oligotrophic (relatively unproductive), those with values between 4 and 10 ug/L as mesotrophic (moderately productive) and those with concentrations greater than 10 ug/L as eutrophic (very productive).

*Chromium

Chromium is an amphoteric metal whose most common oxidation states are +2, +3, and +6. The trivalent and hexavalent forms are of major environmental concern. Because of its low solubility, the trivalent form is rarely found in waters with a pH greater than 5, and when added to most natural waters, is slowly oxidized to the hexavalent form (McNeely et al., 1979). Chromium has many industrial uses. The hexavalent form is used in metal plating, anodizing of aluminum, and in the manufacture of stainless steel, ceramics, paper, and paint. Trivalent chromium is used in photography, in textile dyeing, and in ceramic and glass industries. Chromium is also added to cooling tower waters in inhibit corrosion.

Trivalent chromium is an essential metal for mammals. Deficiencies reduce insulin activation and are known to cause glucose intolerance in humans (USEPA, 1976). Hexavalent chromium is toxic to humans. It is irritating and corrosive to the mucus membranes and is a known carcinogen. Both the trivalent and hexavalent ions are toxic to plants. The toxicity of chromium to aquatic life varies from species to species and is dependent on oxidation state, pH, and temperature (McNeely et al., 1979). Due to its possible toxic effects, the Illinois Pollution Control Board (1977) has determined that total hexavalent and trivalent chromium concentrations in water should not exceed 0.05 mg/L and 1.0 mg/L, respectively.

Cobalt

Cobalt is a heavy metal which may be present in the relatively stable bivalent form, and in the unstable trivalent form. Cobalt is used for making alloys, in nuclear technology, as pigments in the china and glass industry, and in animal feed supplements. As a result, municipal and industrial effluents may contribute cobalt to surface waters. The burning of coal and oil releases cobalt to the atmosphere, which returns to the earth's surface during precipitation events. Natural surface waters usually contains less than 0.1 ug/L cobalt (McNeely et al., 1979). Cobalt concentrations of 1000 ug/L were not found to be harmful to one-year-old tench, carp, rainbow trout and char, nor to crustacea, worms, or insect larvae, although higher concentrations have shown pronounced toxic effects (McKee and Wolf, 1971).

Coliform, Total

Total coliform bacteria are associated with feces of warm-blooded animals as well as in soils and on plants. These bacteria are characterized by gram-negative asporogenous rods.

Coliform, Fecal

Bacteria that comprise a portion of the total coliform group. Fecal coliform are of more sanitary significance than total coliform because they are restricted to the intestinal tract of warm-blooded animals. Consequently, this group serves as an indicator of possible recent sewage contamination.

Conductivity

The measure of the ability of a substance to conduct an electric current. The measurement provides an indication of ion concentration or dissolved solids in water.

*Copper

Although generally present in only trace amounts, copper is a common heavy metal constituent of most natural waters. High concentration of copper may occur in water drainage from mines and some industrial effluents. Copper has been mined and used extensively since prehistoric times. It is used in electrical products, coins, electroplating, and in industrial processes such as gas works, coke ovens and gas scrubbing steel plants. It is often alloyed with other metals to form bronzes and brasses.

Copper is an essential micronutrient for plants and animals. In plants it plays a vital role in chlorophyll synthesis and is a constituent of several enzymes. In animals, copper is important in invertebrate blood chemistry as hemocyanin and in hemoglobin synthesis. Like most metallic micronutrients, relatively high concentrations are toxic. Toxicity varies with oxidation state and a number of physiochemical parameters such as temperature, hardness, alkalinity and turbidity. The Illinois Pollution Control Board (1977) total copper standard for general use waters is 0.02 mg/L.

*Cyanide

Cyanide is one of the simplest and most readily formed organic compounds. Besides being very important in a number of manufacturing processes, cyanide and compounds of cyanide are found in many plants and animals as metabolic intermediates which generally are not stored for long periods of time. Cyanide sources to Lake Michigan have been associated with waste effluents from gas works and coke ovens, gas scrubbing at steel plants, metal cleaning and electroplating processes, and chemical industries. Cyanides are seldom detected in Lake Michigan except in polluted harbors or near the vicinity of harbor mouths (Torrey, 1976). Toxicity varies with pH, temperature and dissolved oxygen.

*Dichloro diphenyl trichloroethane (DDT)

DDT is an aromatic insecticide which accumulates in the fatty tissues of warm-blooded animals. In the past, DDT was widely used to control agricultural pests, many of which were found to have hereditary resistance to the compound. Use of DDT in the United States was prohibited effective January 1, 1973. It is still detected in lakes and streams; the Illinois Pollution Control Board has designated the maximum allowable concentration in public water supply water to be 50.0 ug/L.

*Dieldrin

Dieldrin is an organochlorine compound primarily used as an insecticide. It is an isomer of endrin. The use of dieldrin has been banned and its manufacture has been discontinued in the United States;

however, due to its resistance to decomposition, it is still detected in some lakes and streams. The standard for dieldrin in public water supply waters is 1.0 ug/L (Illinois Pollution Control Board, 1977).

*Endrin

Endrin is an organochlorine compound primarily used an insecticide. The standard for endrin in public water supply waters is 0.2 ug/L (Illinois Pollution Control Board, 1977).

Eutrophic

Eutrophic lakes are nutrient rich and generally are highly productive, capable of supporting a large amount of plant growth and other biological activity. Eutrophic lakes cover a myriad of water quality conditions, ranging from very desirable recreational lakes that support excellent warmwater fisheries, to lakes with undesirable aethetics and water use limitations.

Fungi

Fungi are plants which lack chlorophyll and are able to grow in the absence of light. Favorable growth followed by a large die-off results in disagreeable tastes and odors.

Hardness

Hardness is principally determined by the sum of calcium and magnesium. Water hardness relates to a waters capacity to produce lather from soap. The harder the water, the more difficult it is to lather soap. Hardness ranges from 0-30 mg/L $CaCO_3$ for very soft water and is greater than 180 mg/L $CaCO_3$ for very hard water.

*Hexachlorobenzene (HCB)

HCB is an organochlorine compound used as a fungicide for seeds and as a wood preservative. The USEPA currently recommends an upper limit of 0.5 ppm in fatty tissues of cattle, pigs and sheep; however, this limit is subject to change after further toxicological research. Previous work on laboratory animals indicated a low level of toxicity.

*Hexachlorocychlohexane (BHC)

BHC is an organochlorine compound. The gamma isomer is lindane. It is highly toxic by ingestion, and moderately by inhalation. It can be absorbed through the skin and is a strong irritant to skin and eyes. BHC formerly had extensive use for control of cotton insects. It is no longer produced in the United States and sale for domestic use is prohibited by the USEPA.

Iron

Iron is an abundant element common in many rocks and soils and may be present in water in varying quantities, dependent upon the geology of the area and other chemical components of the waterway. Sources of excess iron include industrial wastes, mine drainage waters, and iron-bearing groundwaters. Iron is an essential micronutrient, and under certain conditions can limit photosynthetic productivity. Iron is considered an objectionable constituent in water supplies, and can affect the taste of beverages and stain laundry. The Illinois Pollution Control Board (1977) has set a maximum allowable iron concentration of 1.0 mg/L in general use waters and 0.30 mg/L in public and food processing water supplies.

*Lead

Due to its low solubility, lead concentrations in water are generally not great. Lead enters the aquatic environment through natural sources, chiefly by the weathering of its sulfide ores. Input from anthropogenic sources clearly exceeds natural sources. Major inputs result from the burning of leaded fuel, ore smelting and refining, storage battery production, and municipal waste discharges. Lead salts are used in printing and dyeing, photography, engraving, and the manufacture of explosives (McNeely et al., 1979).

Lead is not an essential biological element. It is toxic and accumulates in animal tissues. The degree of toxicity, as with other trace metals, is dependent on numerous water quality parameters such as hardness, alkalinity, pH, and others. The toxic effects of lead concentrations on aquatic organisms is highly variable and species dependent (USEPA, 1976). In humans the extent and effect of lead toxicity is age dependent, with young children particularly susceptible to neurological impairment. Accordingly, the Illinois Pollution Control Board (1977) has limited maximum allowable concentrations of total lead to 0.1 mg/L in general use waters and 0.05 mg/L in public and food processing water supplies.

*Lindane

Lindane is the gamma isomer of 1, 2, 3, 4, 5, 6 hexachlorocyclohexane (BHC); the addition product of benzene and chlorine reacting in direct sunlight. This insecticide is a central nervous system stimulant for which there is no specific antidote. The Illinois Pollution Control Board (1977) has set 4.0 ug/L as the maximum lindane concentration for public and food processing water supply waters.

Manganese

Soils and sediments are important sources of manganese along with metamorphic and sedimentary rocks. Manganese is not usually present in appreciable concentrations in surface waters. It seldom reaches concentrations of 1.0 mg/L in natural surface waters and is usually present at levels of 0.2 mg/L or less (McNeely et al., 1979). Industrial wastes and acid-mine drainage may contribute manganese to waters. Manganese is an essential micronutrient, and under certain conditions can limit photosynthetic productivity. Manganese is considered an objectionable constituent in water supplies, and can affect the taste of beverages and stain laundry. The Illinois Pollution Control Board (1977) has set a maximum allowable manganese concentration of 1.0 mg/L in general use waters and public and food processing water supplies.

Magnesium

Magnesium is an alkaline-earth metal which is abundant in natural waters. Magnesium and calcium are the two main components responsible for water hardness. Ferromagnesian minerals in igneous rocks and dolomite sedimentary rocks are the principal contributors of magnesium to water. Industrial waste waters can also be a source of magnesium.

*Mercury

Mercury, the only liquid metal at ordinary temperatures, is a biologically non-essential trace metal. The majority of U.S. waters contain less than 0.1 ug/L total mercury (USEPA, 1976). Historically, because of its toxic effects, mercury was used as a pesticide; however, its use in recent years has been restricted. The major anthropogenic inputs now result from various commercial and industrial processes such as manufacture of paints, mercury switches, dental work, and chlorine gas production.

Mercury compounds are highly toxic to animals, particularly the methylated forms which can be produced by microorganisms from the less toxic inorganic forms. Aquatic organisms are capable of removing mercury directly from water as well as from food. Due to its low elimination rate, mercury is concentrated in body tissues. Concentration factors in fish can be more than 10,000 times aquatic concentrations (USEPA, 1976). Due to its high toxic potential and possible biomagnification in aquatic food webs, the Illinois Pollution Control Board (1977) has determined that acceptable levels of total mercury in Illinois waters should not exceed 0.5 ug/L.

Mesotrophic

Mesotrophic lakes are intermediate in character between oligotrophic and eutrophic. They are moderately supplied with nutrients and generally support moderate biological productivity.

Methoxychlor

Methoxychlor is an organochlorine insecticide. It has a long residual action on many species, but is not highly toxic to warm-blooded animals. The maximum allowable methoxychlor concentration, for public supply waters is 100.0 ug/L (Illinois Pollution Control Board, 1977).

*Nickel

Nickel is a silver-white, metallic element seldom occurring in nature in the elemental form. Nickel salts are soluble and can occur as a leachate from nickel bearing ores. Human activities which may contribute nickel to the environment include the burning of fossil fuels, metal plating and the processing of nickel ores. The median freshwater concentration of nickel in North American rivers is 100 ug/L, although concentrations are often undetectable (McNeely et al., 1979). The Illinois Pollution Control Board (1977) has set a 1000 ug/L as the maximum allowable nickel concentration in general use waters.

Nitrogen, Ammonia

Ammonia nitorgen results from the anaerobic decomposition of nitrogenous organic matter. It may be present in surface waters as a result of agricultural runoff, certain industrial wastes, and runoff from pastures or feedlots. It is a component of sewage and relatively high concentrations may be found in the effluents of sewage treatment facilities. The importance of ammonia in freshwater is associated with its toxicity to fishes (this toxicity varies with water temperature and pH) and its potential for conversion to nitrogen forms readily assimilated by aquatic plants. The maximum allowable ammonia nitrogen concentration in Lake Michigan is 0.02 mg/L (Illinois Pollution Control Board, 1977).

Nitrogen, Nitrite-Nitrate

Nitrate-nitrogen is commonly found in surface waters as a result of the aerobic decomposition of organic nitrogen in polluted streams and from sewage effluents, agricultural runoff, cesspool leaching, and industrial discharges. Nitrites in natural waters result from bacterial oxidation of ammonia and organic nitrogen. Because they are readily oxidized to nitrates, nitrites are not normally found in significant concentrations. In addition to serving as plant nutrients, nitrate-nitrite is also a major public health consideration because high concentrations may cause infant methemoglobinemia (blue baby syndrome).

Nitrogen, Organic

Organic nitrogen is defined functionally as organically bound nitrogen. Organic nitrogen includes such natural materials as proteins and peptides, nucleic acids and urea, and numerous synthetic organic materials.

Nonachlor

Nonachlor is an organochlorine compound which is a product of technical chlordane. It is used as an insecticide.

Odor, Threshold

Odor is recognized as a quality factor affecting water in several ways: acceptability of drinking water, tainting of fish and other aquatic organisms, and aesthetics of recreational waters. Odor tests are performed to arrive at qualitative descriptions and approximate quantitative measurements of odor intensity. The method for intensity measurement is the threshold odor test.

Oligotrophic

Oligotrophic lakes have low concentrations of nutrients such as phosphorus and nitrogen and support little plant growth. Biological productivity is generally low, and the waters are clear.

Oxygen Demand, Chemical

A measure of the oxygen-consuming capacity of inorganic and organic matter present in water or wastewater.

*Pentachlorophenol

Pentachlorophenol (PCP) is a chlorinated hydrocarbon that is prepared commercially by the chlorination of phenol in the presence of a catalyst. It is used primarily as a wood preservative, herbicide, insecticide, molluscicide, bactericide, fungicide and slimicide. PCP is slightly soluble in water; it's sodium phenate salt is highly soluble in water. PCP decomposes into several products including lower chlorophenol isomers, anisoles, dibenzofurans and dioxins. It can also be a degradation product of hexachlorobenzene (HCB) and lindane.

pH

pH is a logarithm of the reciprocal of the hydrogen ion concentration. pH measures the balance between the acids and bases in water by the concentration of hydrogen ions. By definition, the pH range is from 0 (most acidic) to 14 (most alkaline). Since the concentration of hydrogen ions regulates the degree of dissociation of many substances, pH may be a significant factor in determining limiting threshold concentrations in natural waters. According to the Illinois Pollution Control Board (1977), the pH of Lake Michigan shall be within the range of 7.0 to 9.0 except for natural causes.

Phenols

Phenols are associated with industrial wastes from coal distillation processes and the manufacture of plastics, dyes, and disinfectants. Relatively small concentrations can cause taste and odor problems in public water supplies.

Pheophytin

A brown pigment, produced by the degradation of chlorophyll.

Phosphate, Total

Phosphate is found in domestic sewage, some industrial wastes, and drainage from agricultural areas. It is one of the nutrients responsible for excessive algae growth. The Illinois Pollution Control Board (1977) specifies a total phosphate water quality standard of 0.021 mg/L (or 0.007 mg/L as P) for Lake Michigan.

Phosphate, Dissolved (Total Filterable)

The phosphate forms that pass through a 0.45 um membrane.

Plankton

Minute animals (zooplankton) and plants (phytoplankton) that are suspended in a body of water and, because of their physical character or size, are incapable of sustained mobility in directions counter to water currents.

Plate count

Number of colonies of bacteria grown on selected solid media at a given temperature and incubation period. The procedure provides a standardized means of determining the density of bacteria in water.

*Polychlorinated biphenyls (PCB's)

PCB's are not pesticides per se, however, the "kill life" of chlorinated hydrocarbon insecticides is extended via the synergistic effects of PCB's. PCB's are resistant to degradation by ordinary physical and chemical means; they will only decompose if heated to 950°C. As a result, even banning the use and manufacture of PCB's in the United States is not completely effective in removing PCB's from the environment. They are insoluble in water and accumulate in the lipids of living systems. Concentrated in the food web, PCB's can cause human disorders ranging from fatigue to bone deformities.

Potassium

Naturally occuring element that is an essential plant nutrient. High concentrations in water may be a result of discharge, groundwater or sedimentary runoff.

Residue, Filterable

The dissolved mineral constituents of water that will pass through a 0.45 um filter and remain after evaporation. Also called total dissolved solids.

Residue, Nonfilterable

The portion of the total residue retained by a 0.45 um filter.

Secchi Disc Transparency

Secchi disc transparency is a measure of the clarity or transparency of the water. It is the depth to which a weighted metal plate with alternating black and white quadrants lowered into the water by a calibrated rope is visible. Measurements taken with a secchi disc indicate the light penetration into a body of water. Algae, zooplankton, water color and sediment are factors which interfere with light penetration and lessen the secchi transparency.

Silica, (SiO_2)

Silica is a nutrient essential to diatoms, which incorporate it into their cell walls. Increases in diatom populations cause a reduction in silica concentrations.

*Silver

Silver is found in its elemental state as well as in combination with several ores. Significant levels of silver in natural waters are low because of the insolubility of silver salts such as chloride, sulfide, phosphate and arsenate. Freshwater concentrations of silver range from 0.2 ug/L to 39 ug/L (McNeely et al., 1979). Silver metal is used in jewelry and silverware, in alloys for electroplating and the processing of food and beverages. Silver nitrate is used in photography, ink manufacturing, electroplating, coloring porcelain, and as an antiseptic (McKee and Wolf, 1971).

Sodium

Naturally occurring element in surface waters. Relatively high concentrations may be found in brines and hard waters.

Streptococci, Fecal

The fecal streptococcal group of bacteria is closely associated with sewage discharges. This group serves as a supplementary indicator of recent sewage contamination.

Strontium

Strontium is an alkaline-earth metal that is chemically similar to calcium. It is not found free in nature, but occurs chiefly with calcium or barium minerals, in the form of sulfate or carbonate. Strontium salts are only slightly soluble in water. The weathering of sedimentary rocks are the principal sources of strontium to the aquatic environment. There are no significant industrial sources of strontium, however, nuclear bomb tests resulted in radioactive strontium-90 fallout. Most natural surface waters contains only a few milligrams per liter (McNeely et al., 1979).

Sulfate

Sulfate is a component of natural bodies of water. Abnormal fluctuations in background levels may be the result of industrial waste discharges as well as atmospheric precipitation resulting from the burning of fossil fuels. In drinking water supplies, high sulfate concentrations may have a cathartic effect. The maximum allowable sulfate concentration in Lake Michigan is 24.0 mg/L (Illinois Pollution Control Board, 1977).

Trophic State Index (TSI)

Calculating a Trophic State Index is commonly used method for classifying lakes according to eutrophic condition. The higher the TSI value, the more eutrophic the lake. Each major division (10, 20, 30, etc.) of the index represents a doubling of algal biomass. TSI values can be calculated from Secchi disc transparency (SD), total phosphorus (TP), and chlorophyll a (CHLa). Lakes with TSI values below 40 are considered oligotrophic. Those with TSI values between 40 and 50 are considered mesotrophic, and those with TSI values greater than 50 are considered eutrophic.

Turbidity

Turbidity is a measure of the suspended particles such as silt, clay, organic matter, plankton, and microscopic organisms in water which are usually held in suspension by turbulent flow and Browian movement. Turbidity is measured by comparing the optical interferences of suspended particles to the transmission of light in an instrument previously standardized with samples of standard turbidity units.

Vanadium

Metallic vanadium does not occur free in nature, but minerals containing vanadium are widespread. Vanadium has several valence states. The trivalent salts are insoluble but the tetravalent and pentavalent salts are soluble in water. The pentavalent salts have the greater toxicity. Vanadium metal is used in metallurgy to increase the hardness and malleability of steel, and the salts are used in the manufacture of glass, in photography and as a mordant in dyeing and printing fabrics. It is also used in automobile catalytic converters to which reduce hydrocarbon emissions. The burning of fossil fuels also releases vanadium to the environment.

*Zinc

Zinc is a biologically essential trace metal, and a necessary component of certain plant and animal enzymes. It is generally found in nature as a sulfide associated with other metals such as lead, copper, cadium, and iron, Industrially, zinc is important in galvanizing, in the preparation of alloys for die casting, in brass and bronze alloys, and in certain chemical products such as paint, fertilizers and pesticides.

Zinc is relatively non-toxic to man, with public drinking water concentrations limited on an aesthetic basis. Zinc, however is acutely and chronically toxic to aquatic organisms, especially fish (McNeely et al. 1979). The degree of toxicity is determined by a number of parameters including pH, DO, hardness, temperature, and alkalinity. The Illinois Pollution Control Board (1977) has set 1.0 mg/L as the maximum allowable zinc concentration in general use waters.

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* On the USEPA list of 129 priority pollutants

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